Fig. 1

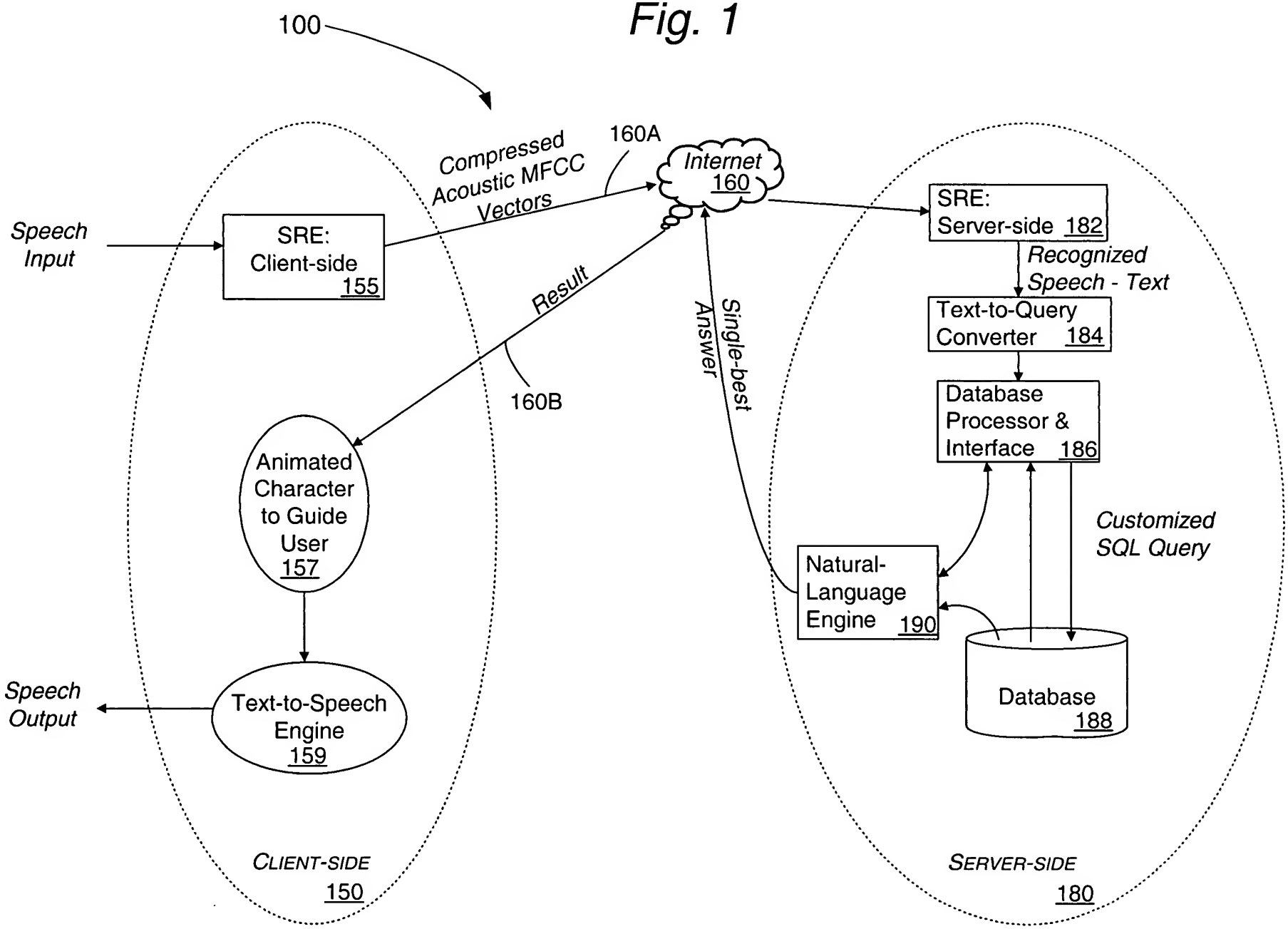

100
Speech Input
SRE: Client-side 155
Compressed Acoustic MFCC Vectors
160A
Internet 160
Result
160B
Single-best Answer
SRE: Server-side 182
Recognized Speech - Text
Text-to-Query Converter 184
Database Processor & Interface 186
Customized SQL Query
Natural-Language Engine 190
Database 188
Animated Character to Guide User 157
Speech Output
Text-to-Speech Engine 159
CLIENT-SIDE 150
SERVER-SIDE 180

Figure 2A

CLIENT-SIDE SYSTEM LOGIC

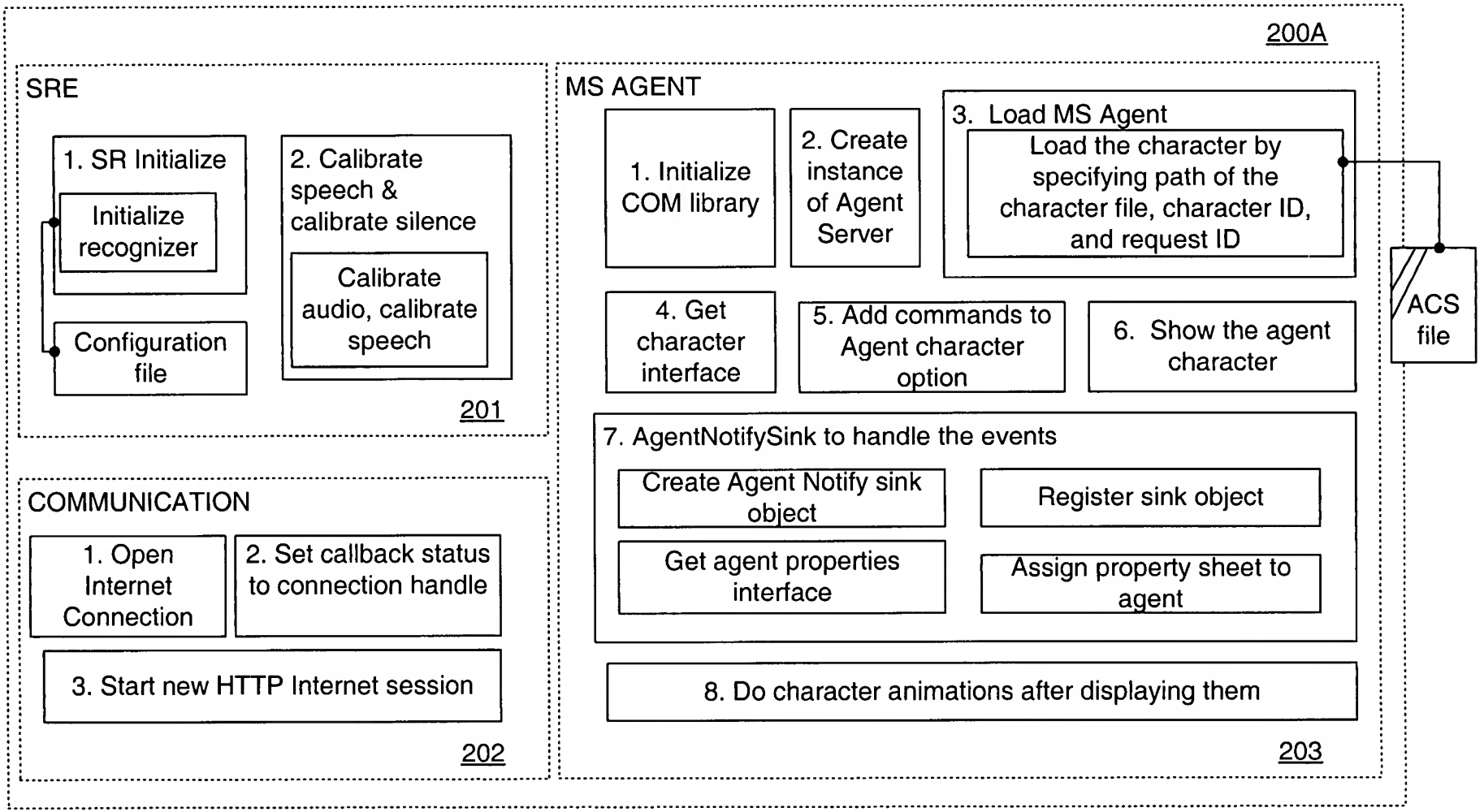


Figure 2B

CLIENT-SIDE SYSTEM LOGIC

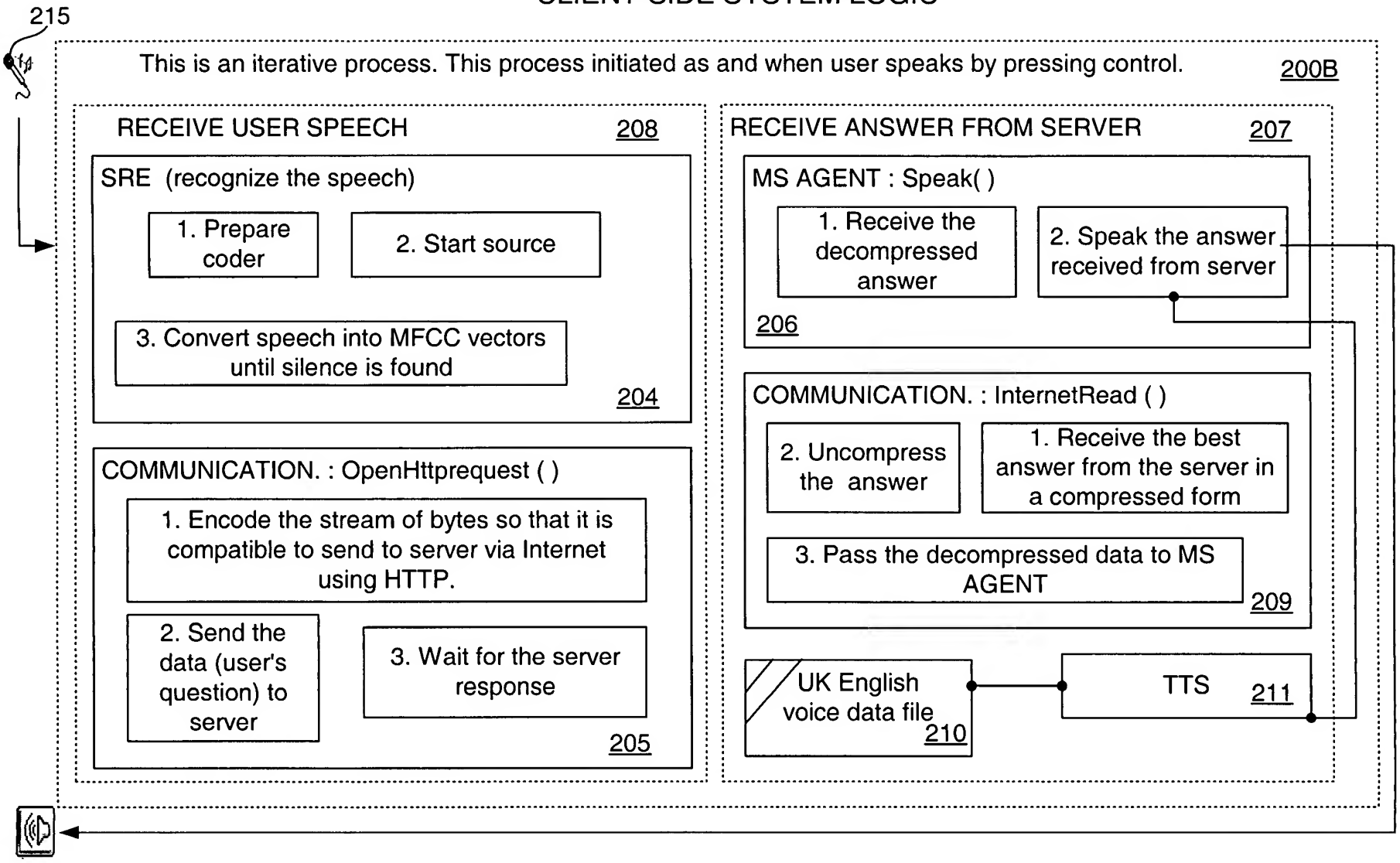


Figure 2C

CLIENT-SIDE SYSTEM LOGIC

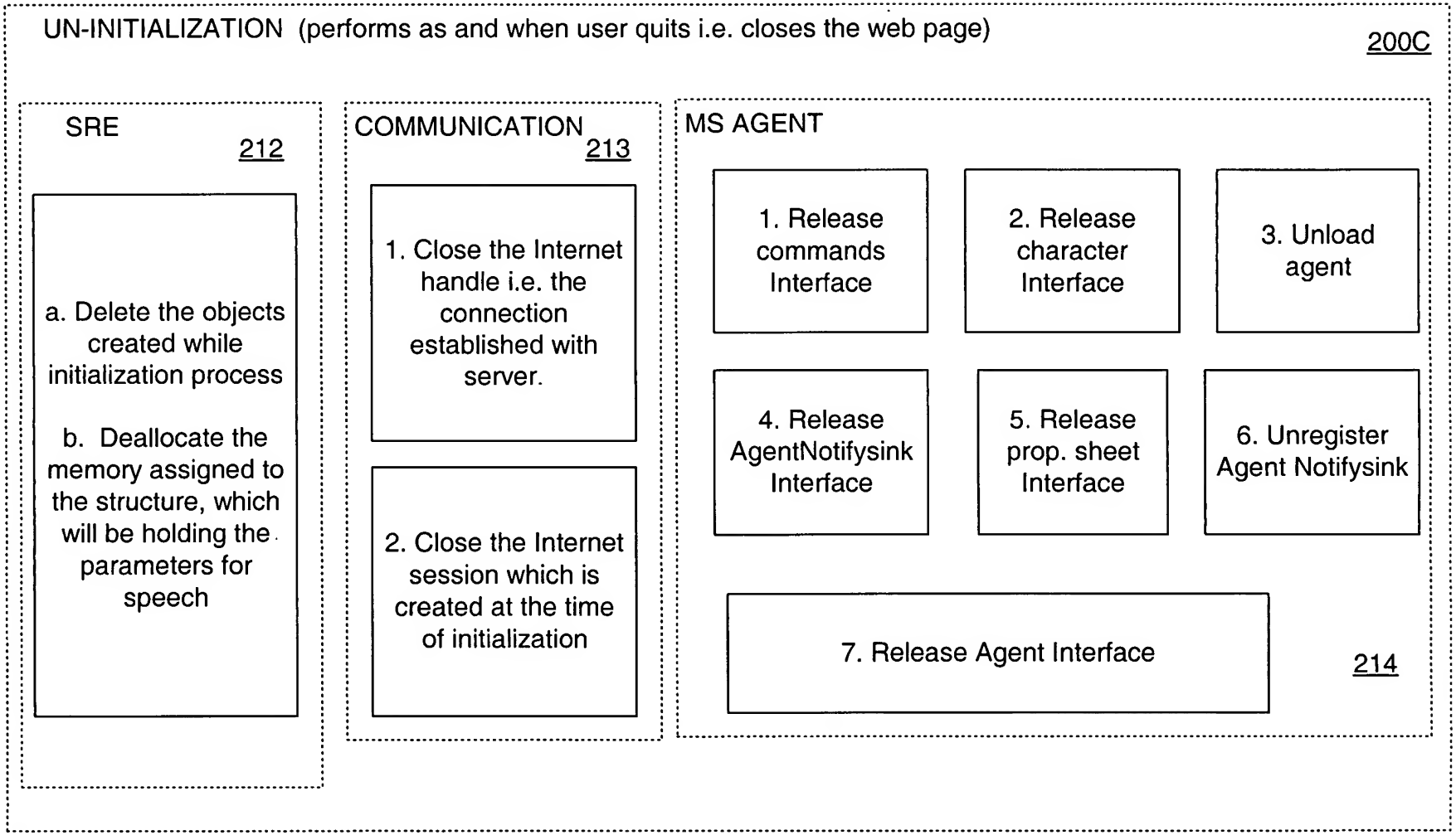


Fig. 2D

Cli nt-sid Initialization

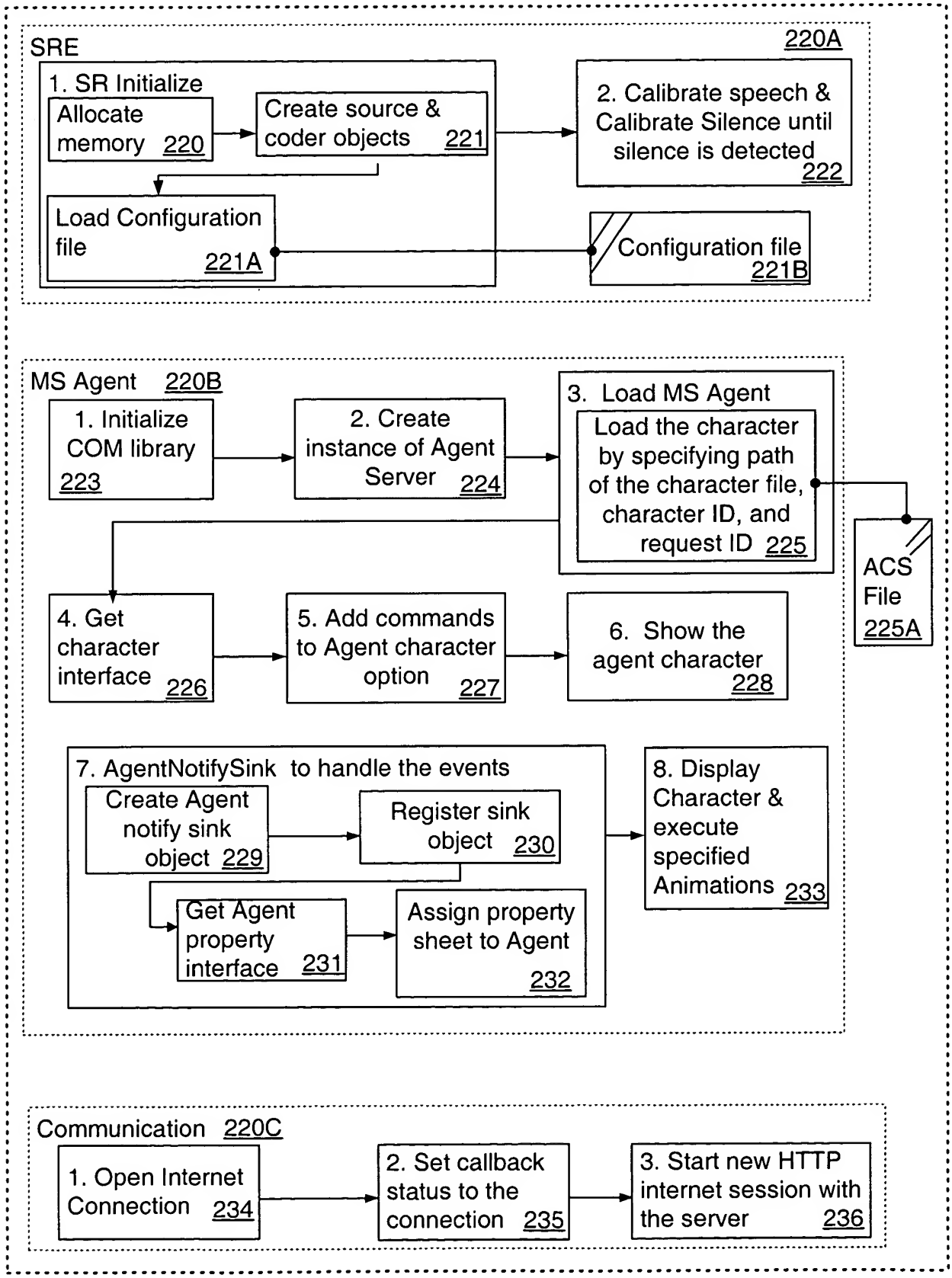


Fig. 3

Client-sid Iterative Process

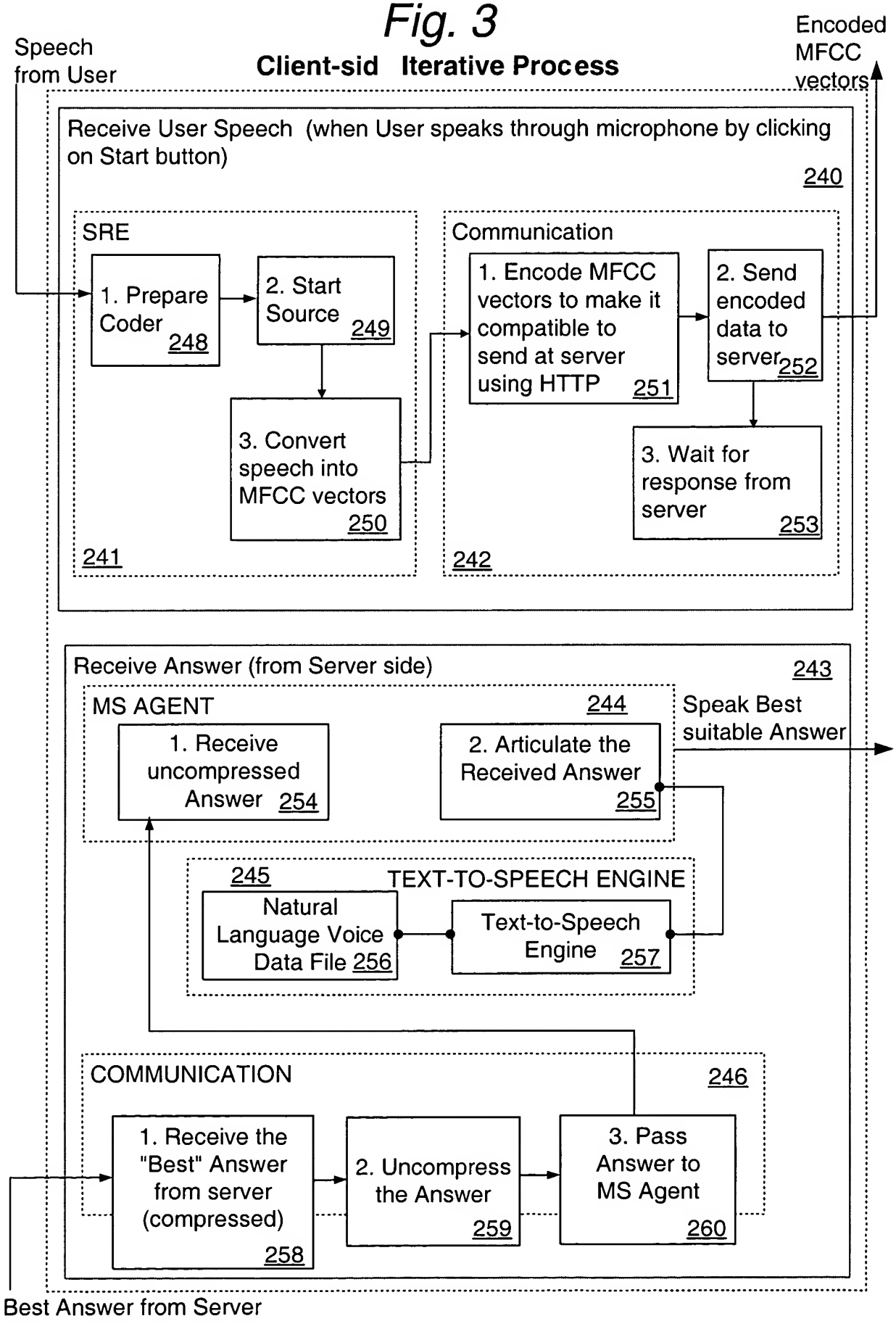


Fig. 4

Client-side Un-Initialization

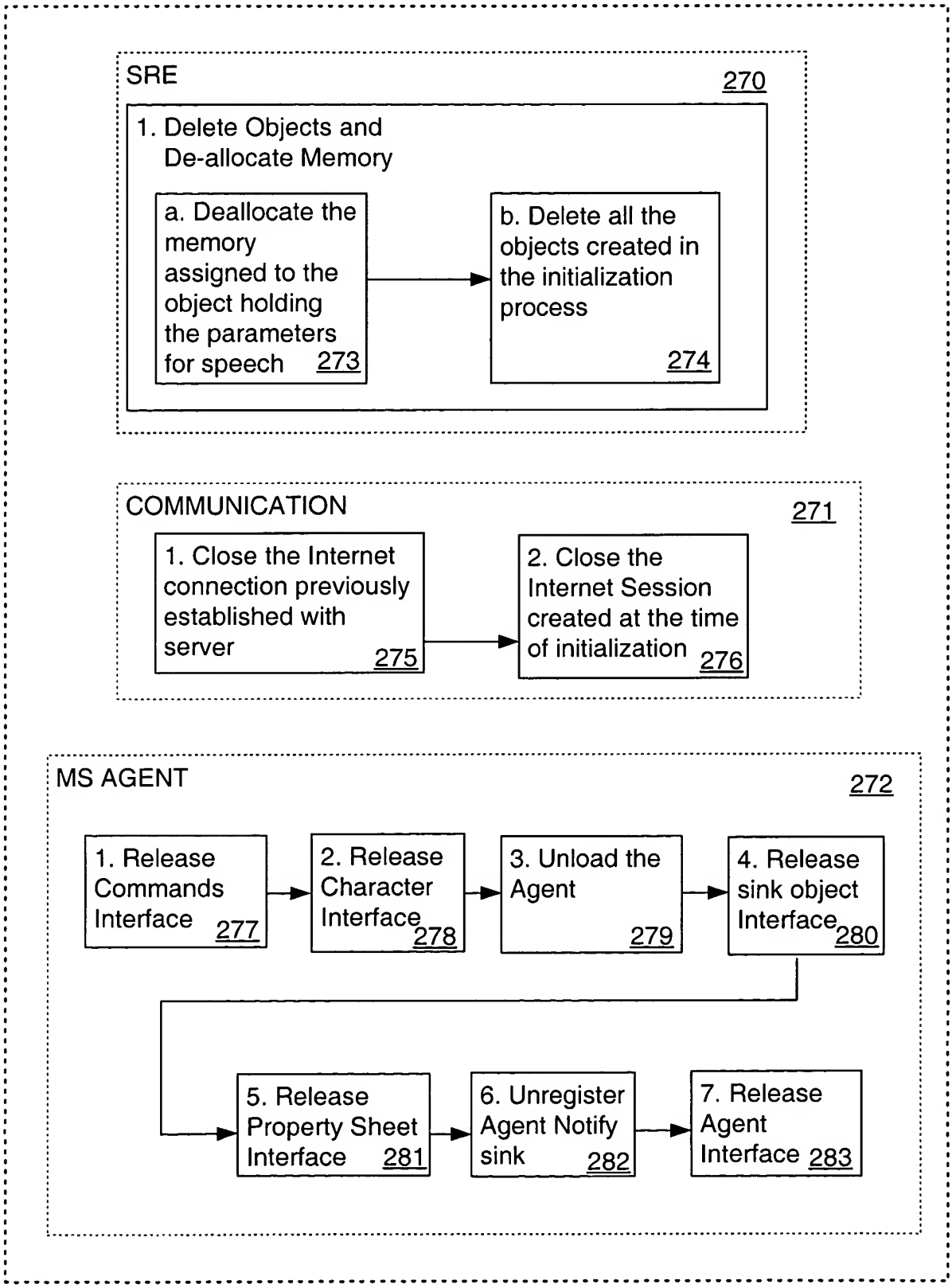
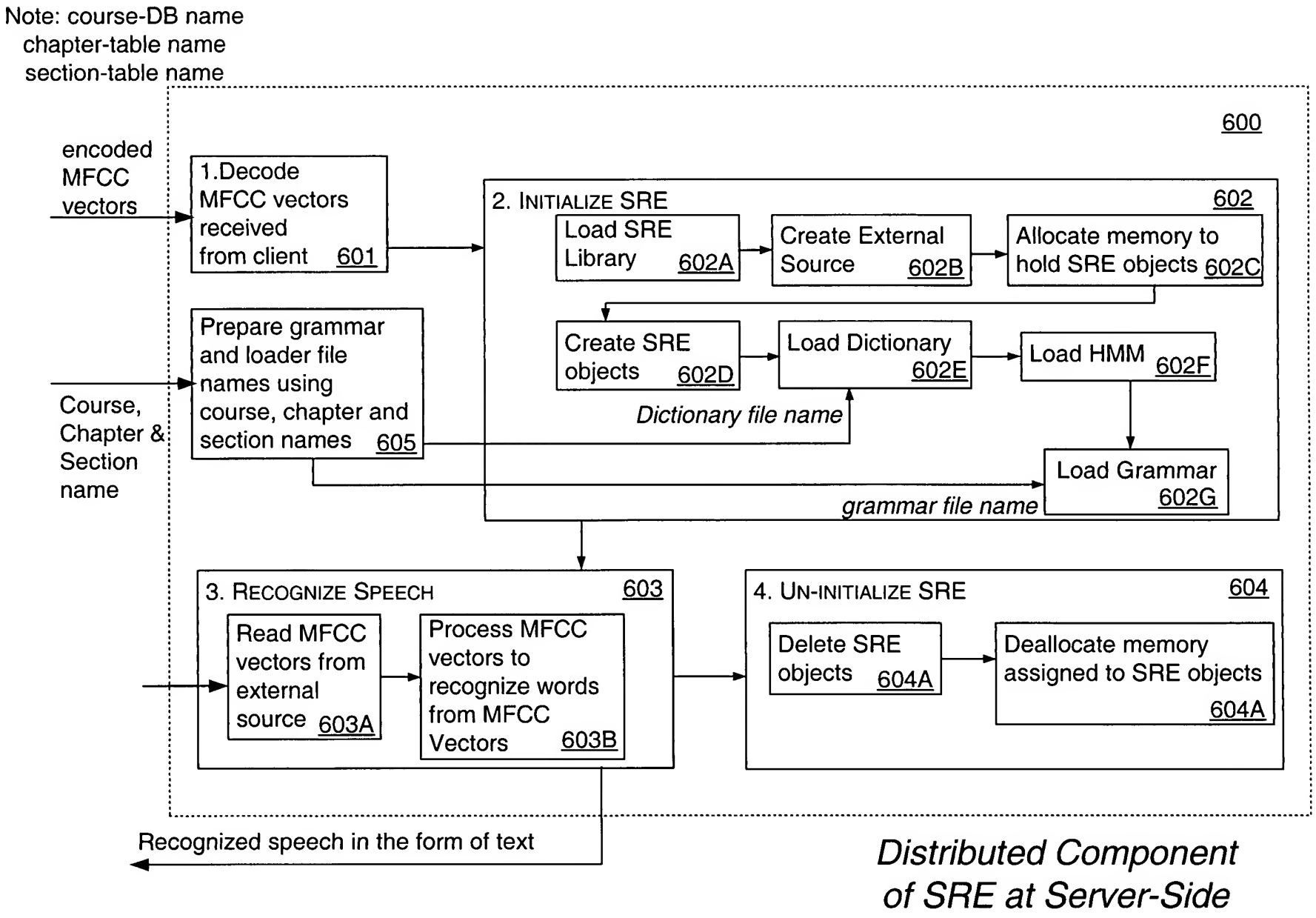


Fig. 4A



Distributed Component of SRE at Server-Side

Fig. 4B

Build of SQL Query

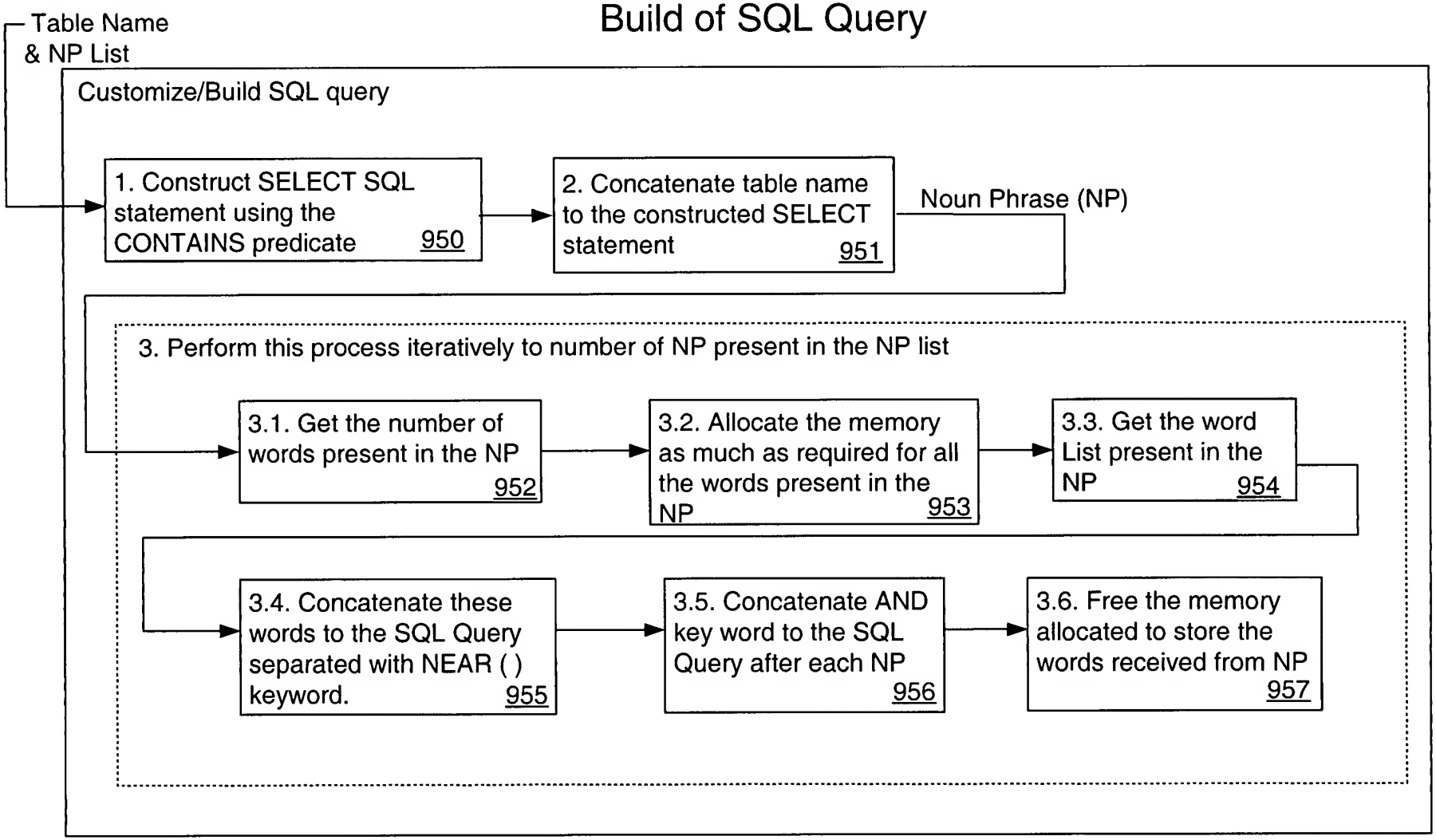


Fig. 4C

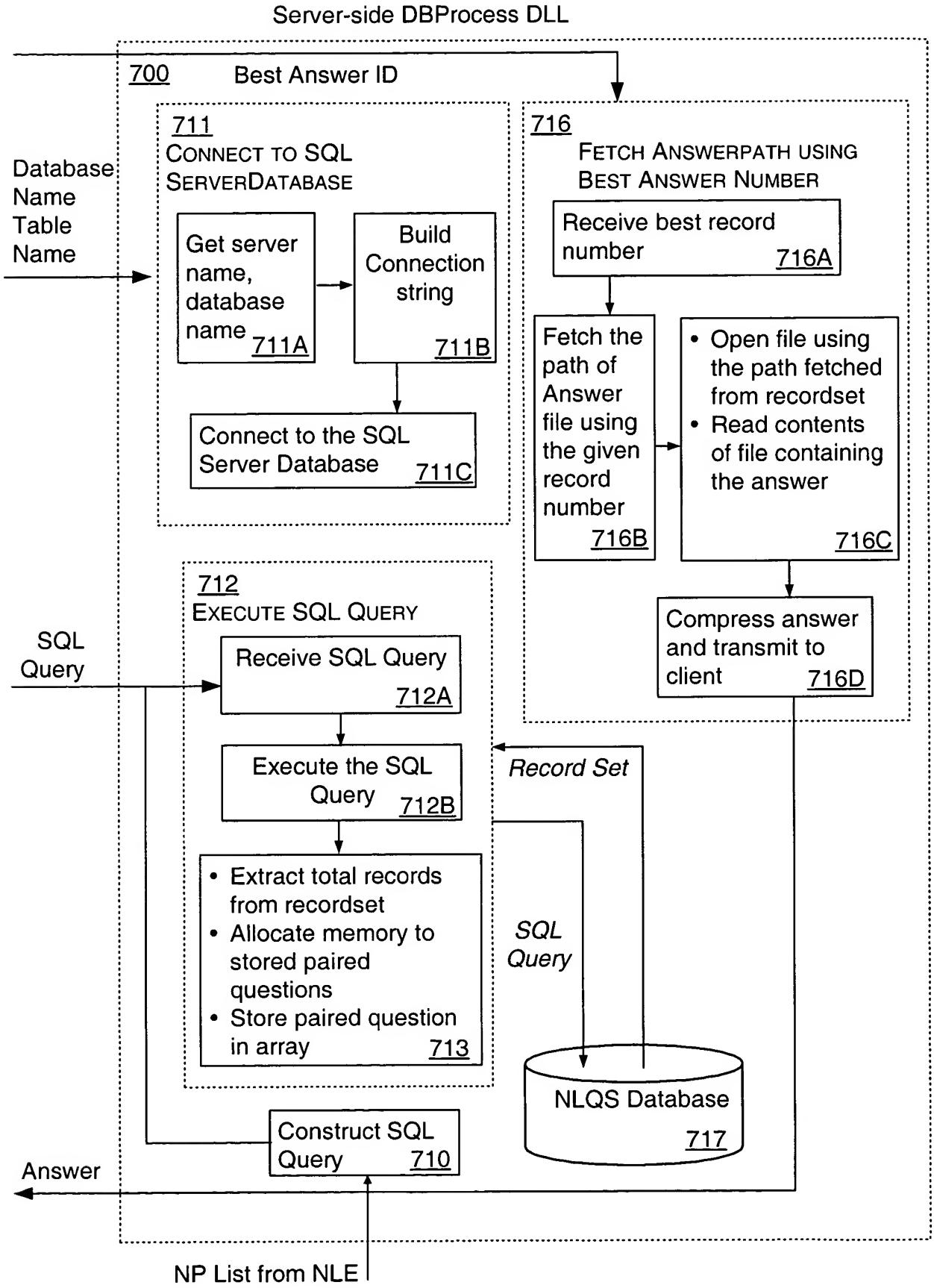

Server-side DBProcess DLL
700
Best Answer ID
711
CONNECT TO SQL SERVERDATABASE
Database Name
Table Name
Get server name, database name 711A
Build Connection string 711B
Connect to the SQL Server Database 711C
716
FETCH ANSWERPATH USING BEST ANSWER NUMBER
Receive best record number 716A
Fetch the path of Answer file using the given record number 716B
• Open file using the path fetched from recordset
• Read contents of file containing the answer 716C
Compress answer and transmit to client 716D
712
EXECUTE SQL QUERY
SQL Query
Receive SQL Query 712A
Execute the SQL Query 712B
Record Set
• Extract total records from recordset
• Allocate memory to stored paired questions
• Store paired question in array 713
SQL Query
NLQS Database 717
Construct SQL Query 710
Answer
NP List from NLE

Fig. 4D

Note: PQ - Paired Question
NP- Noun Phrase
Red Line - I / O

Int rfac Logic between NLE and DBProcess.DLL

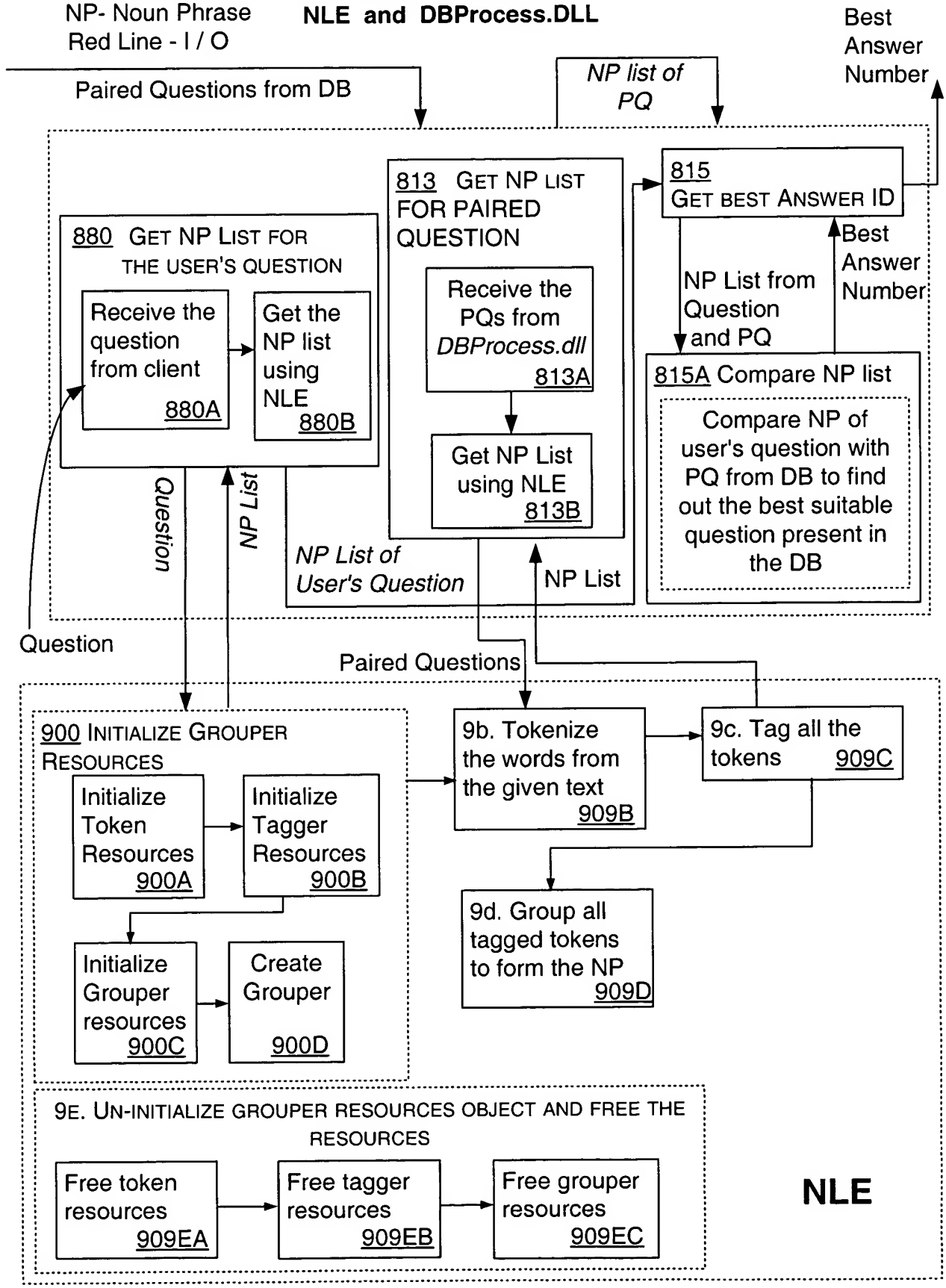


Fig. 5

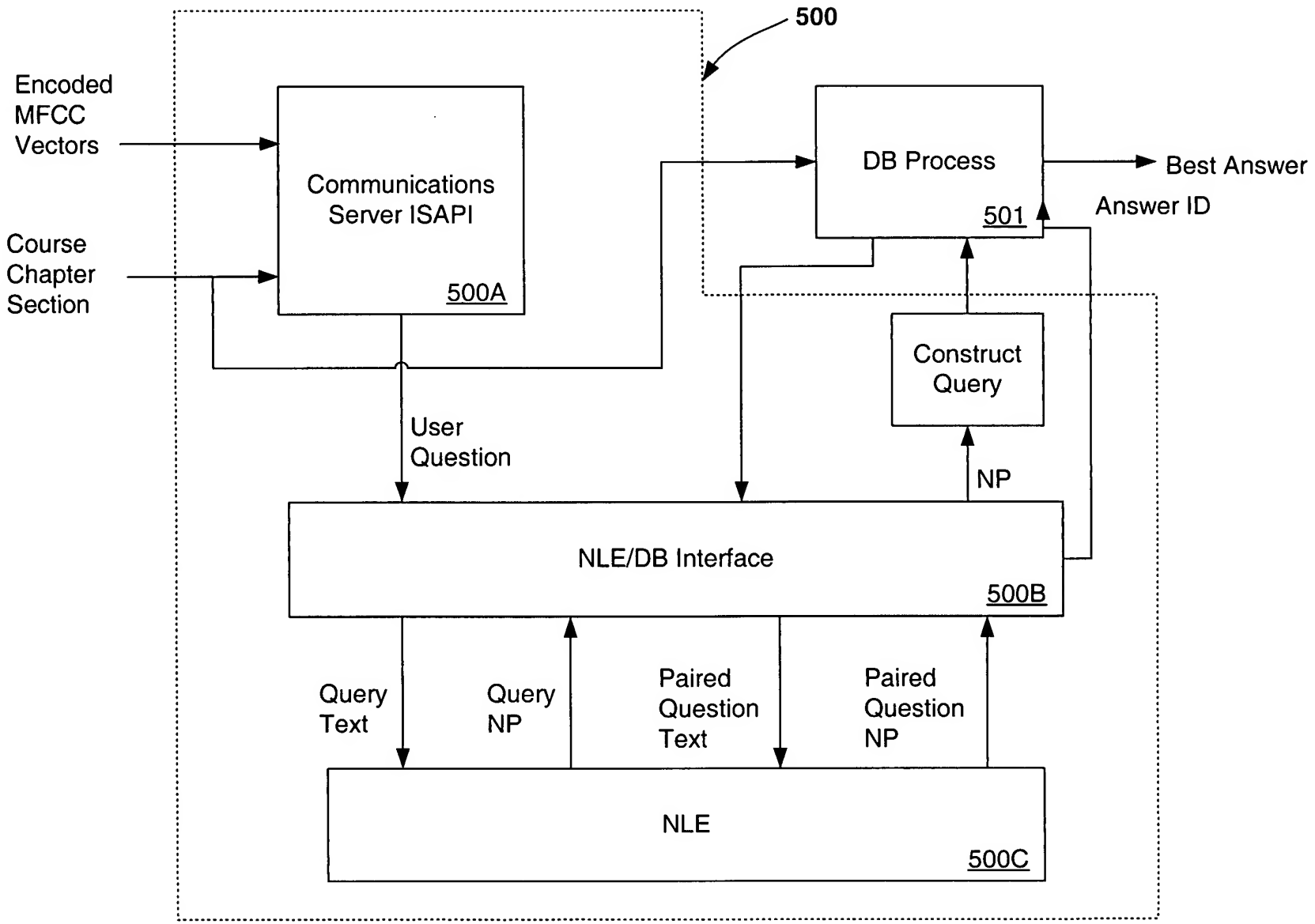

500
Encoded
MFCC
Vectors
Course
Chapter
Section
Communications
Server ISAPI
500A
DB Process
501
Best Answer
Answer ID
Construct
Query
User
Question
NP
NLE/DB Interface
500B
Query
Text
Query
NP
Paired
Question
Text
Paired
Question
NP
NLE
500C

Fig.6

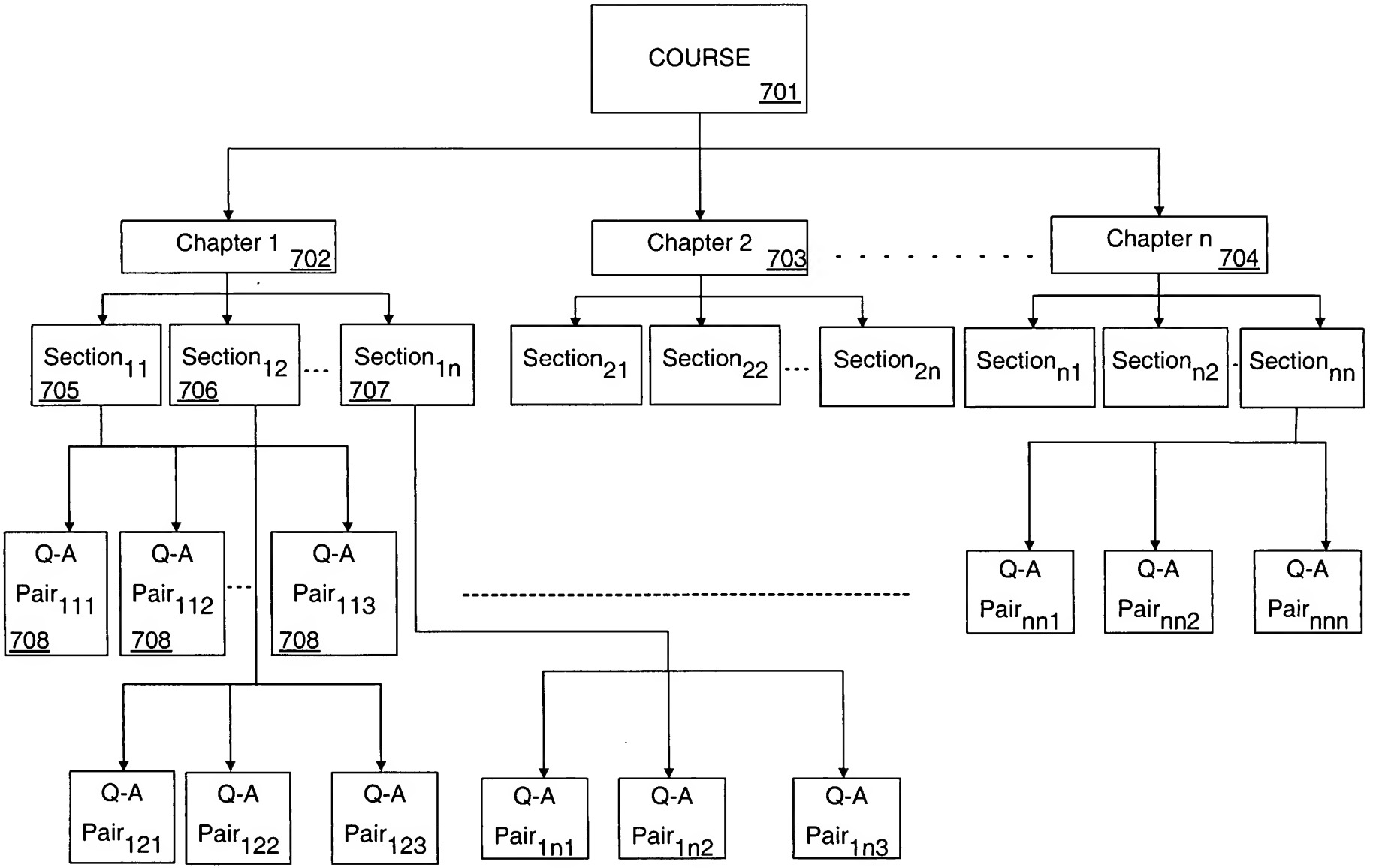

COURSE
701
Chapter 1
702
Chapter 2
703
Chapter n
704
Section11
705
Section12
706
Section1n
707
Section21
Section22
Section2n
Sectionn1
Sectionn2
Sectionnn
Q-A Pair111
708
Q-A Pair112
708
Q-A Pair113
708
Q-A Pairnn1
Q-A Pairnn2
Q-A Pairnnn
Q-A Pair121
Q-A Pair122
Q-A Pair123
Q-A Pair1n1
Q-A Pair1n2
Q-A Pair1n3

Fig.7A

FIELD NAME 701A	DATA TYPE 702A	SIZE 703A	NULL 704A	PRIMARY KEY 705A	INDEXED? 706A
ChapterName 707A	Varchar	255	No	No	Yes
SectionName 708A	Varchar	255	No	No	Yes

Fig.7B

FIELD NAME 720	DATA TYPE 721	SIZE 722	NULL 723	PRIMARY KEY 724	INDEXED? 725
Chapter_ID 726	Integer		No	Yes	Yes
Answer_ID 727	Char	5	No	UNIQUE	Yes
Section_Name 728	Varchar	255	No	UNIQUE	Yes
Answer_Title 729	Varchar	255	Yes	No	Yes
PairedQuestion 730	Text	16	No	No	Yes (Full-Text)
AnswerPath 731	Varchar	255	No	No	Yes
Creator 732	Varchar	50	No	No	Yes
Date_of_Creation 733	Date	-	No	No	Yes
Date_of_Modification 734	Date	-	No	No	Yes

Fig. 7C

Field 720	Description 735
AnswerID 727	An integer - automatically incremented for user convenience
Section_Name 728	Name of section to which the particular record belongs. This field along with AnswerID has to be made primary key
Answer_Title 729	A short description of the answer
PairedQuestion 730	Contains one or more combinations of questions for the related answer whose path is stored in the next column AnswerPath
AnswerPath 731	Contains the path of text file, which contains the answer to the related questions stored in the previous column
Creator 732	Name of content creator
Date_of_Creation 733	Date on which content has been added
Date_of_Modification 734	Date on which content has been changed or modified

Fig. 7D

FIELD 740	DATA TYPE 741	SIZE 742	NULL 743	PRIMARY KEY 744	INDEXED 745
Answer_ID 746	Char	5	No	Yes	Yes
Answer_Title 747	Varchar	255	Yes	No	No
PairedQuestion 748	Text	16	No	No	Yes (Full-Text)
Answer_Path 749	Varchar	255	No	No	No
Creator 750	Varchar	50	No	No	No
Date_of_Creation 751	Date	-	No	No	No
Date_of_Modification 752	Date	-	No	No	No

Fig. 8

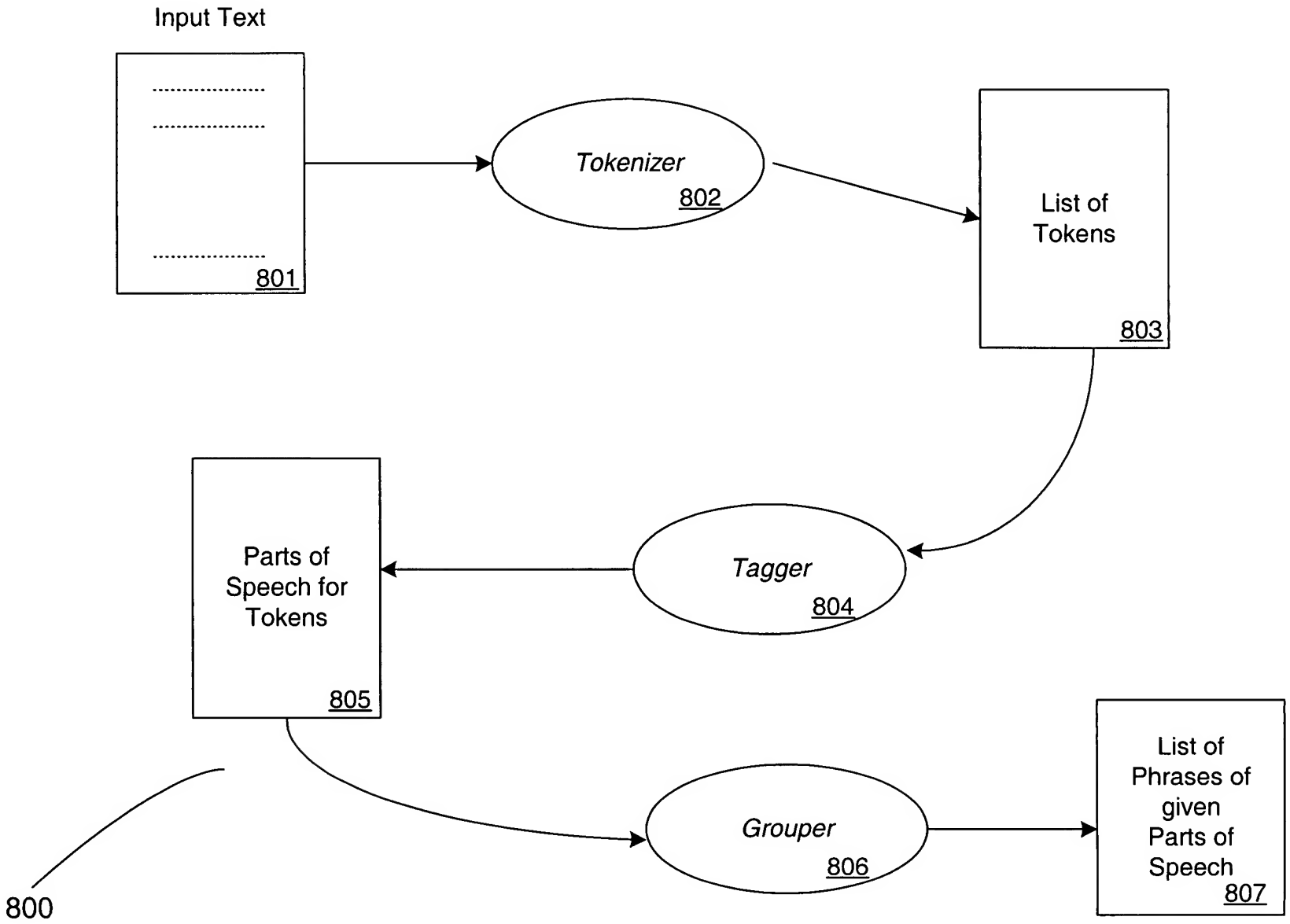

Input Text
801
Tokenizer
802
List of Tokens
803
Tagger
804
Parts of Speech for Tokens
805
Grouper
806
List of Phrases of given Parts of Speech
807
800

Fig. 9

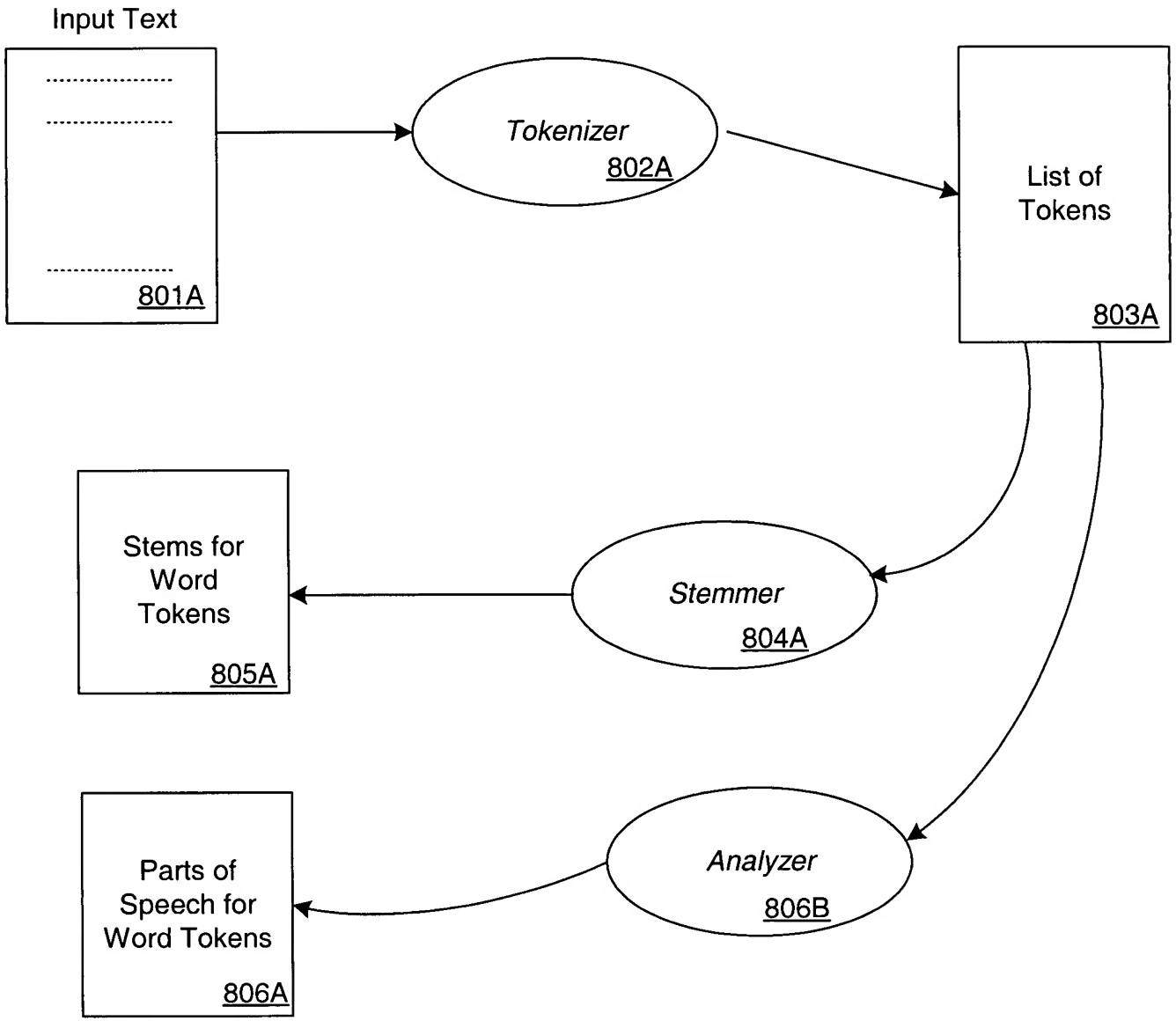

Input Text
801A
Tokenizer
802A
List of Tokens
803A
Stemmer
804A
Stems for Word Tokens
805A
Analyzer
806B
Parts of Speech for Word Tokens
806A

Fig. 10

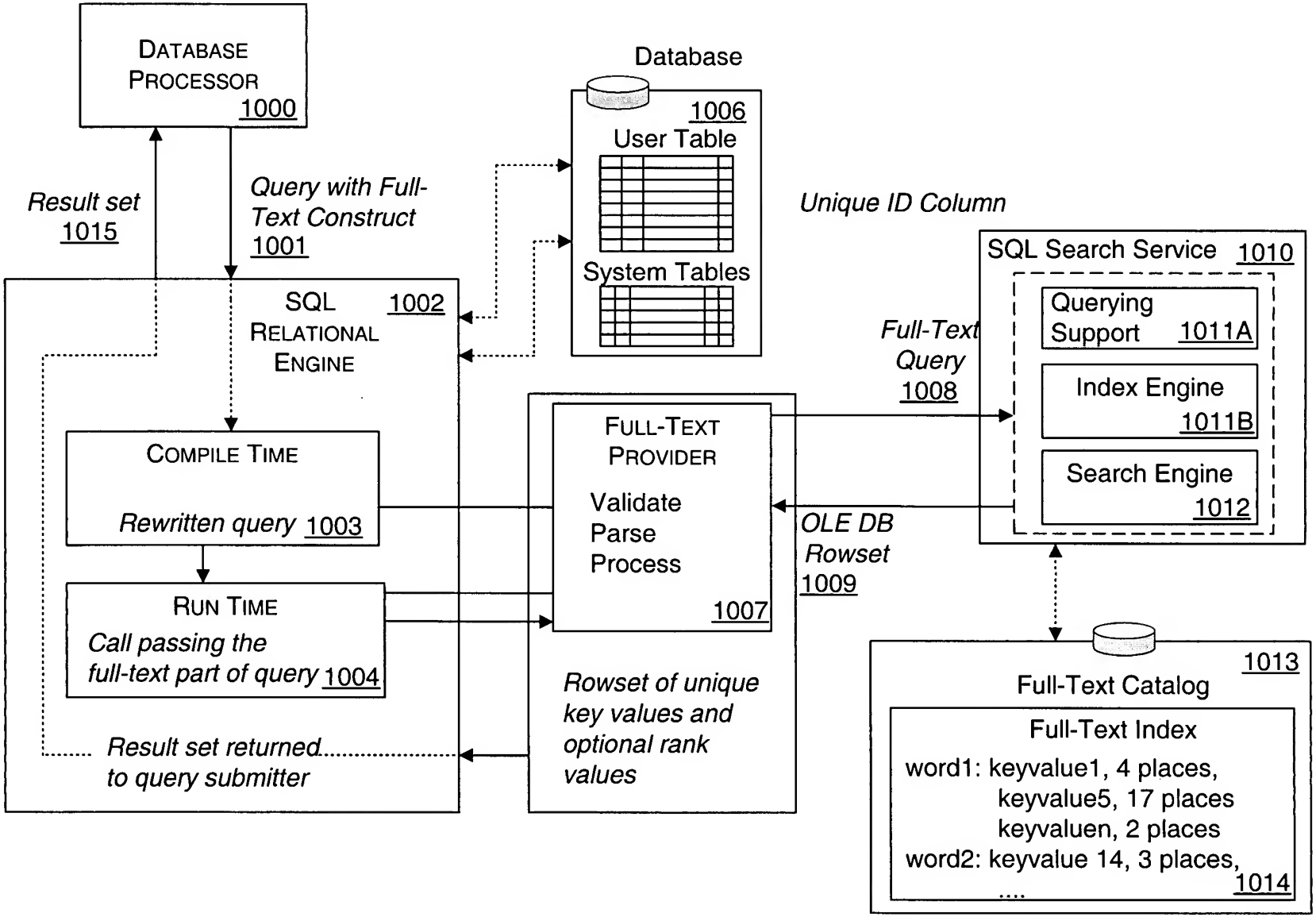

DATABASE PROCESSOR 1000
Database
1006
User Table
System Tables
Result set 1015
Query with Full-Text Construct 1001
Unique ID Column
SQL Search Service 1010
Querying Support 1011A
Index Engine 1011B
Search Engine 1012
SQL RELATIONAL ENGINE 1002
Full-Text Query 1008
COMPILE TIME
Rewritten query 1003
FULL-TEXT PROVIDER
Validate
Parse
Process
1007
OLE DB Rowset 1009
RUN TIME
Call passing the full-text part of query 1004
Rowset of unique key values and optional rank values
Result set returned to query submitter
1013
Full-Text Catalog
Full-Text Index
word1: keyvalue1, 4 places,
keyvalue5, 17 places
keyvaluen, 2 places
word2: keyvalue 14, 3 places,
....
1014

Fig. 11A

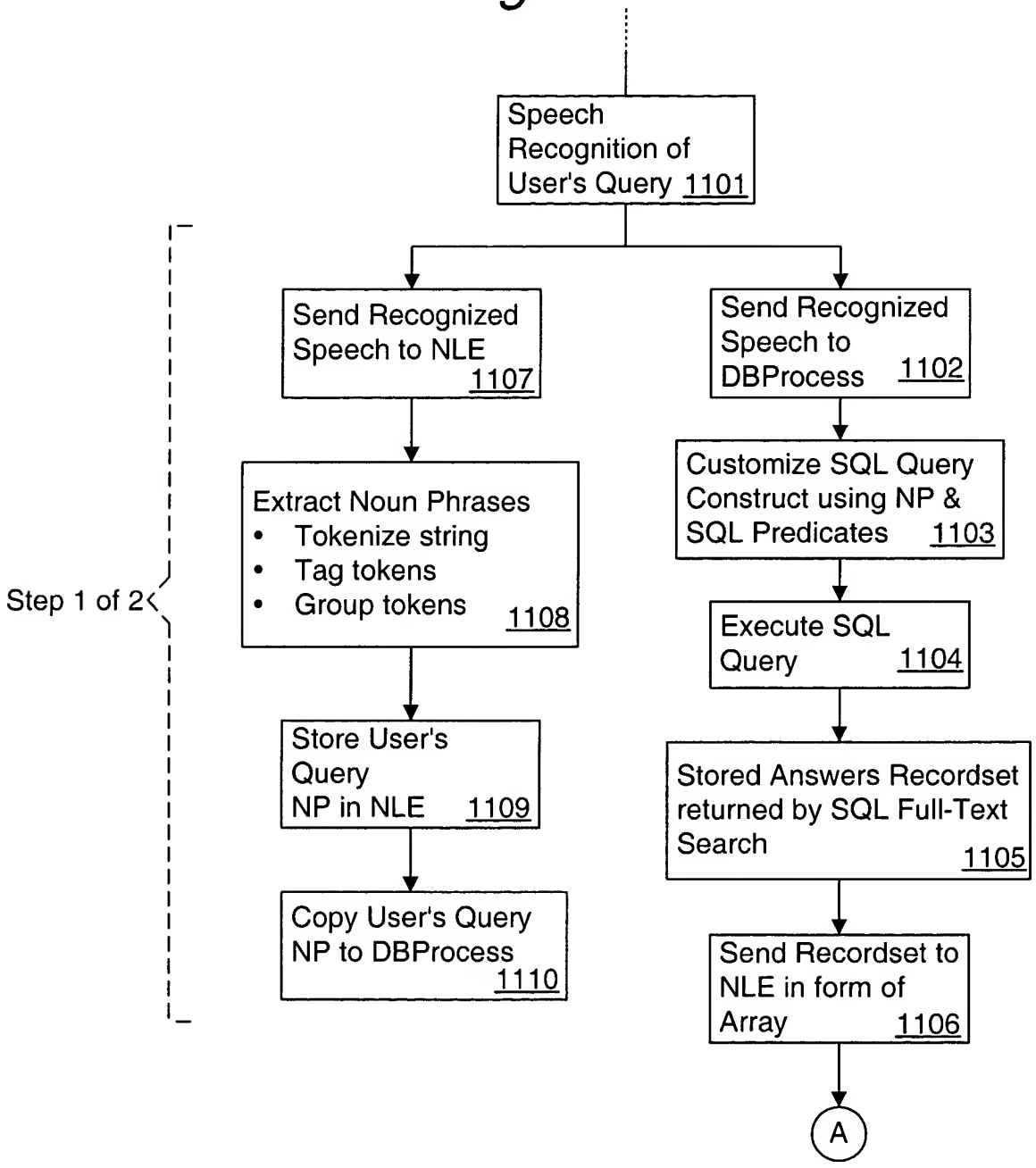

Speech Recognition of User's Query 1101
Send Recognized Speech to NLE 1107
Send Recognized Speech to DBProcess 1102
Extract Noun Phrases
• Tokenize string
• Tag tokens
• Group tokens 1108
Customize SQL Query Construct using NP & SQL Predicates 1103
Execute SQL Query 1104
Store User's Query NP in NLE 1109
Stored Answers Recordset returned by SQL Full-Text Search 1105
Copy User's Query NP to DBProcess 1110
Send Recordset to NLE in form of Array 1106
A
Step 1 of 2

Fig. 11B

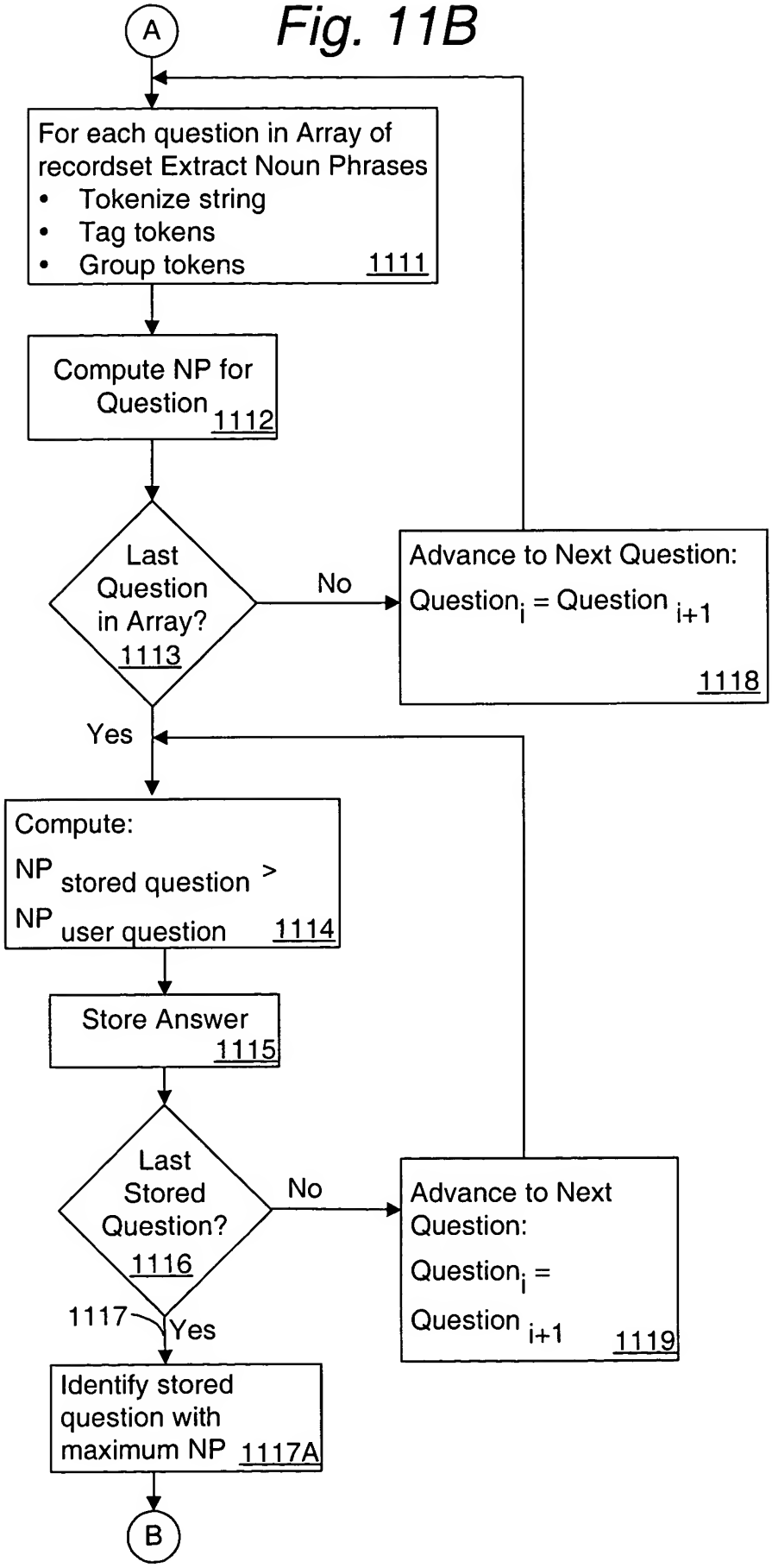

A
For each question in Array of recordset Extract Noun Phrases
• Tokenize string
• Tag tokens
• Group tokens
1111
Compute NP for Question
1112
Last Question in Array?
1113
No
Advance to Next Question:
Question$_i$ = Question $_{i+1}$
1118
Yes
Compute:
NP stored question >
NP user question
1114
Store Answer
1115
Last Stored Question?
1116
No
Advance to Next Question:
Question$_i$ =
Question $_{i+1}$
1119
1117
Yes
Identify stored question with maximum NP
1117A
B

Fig. 11C

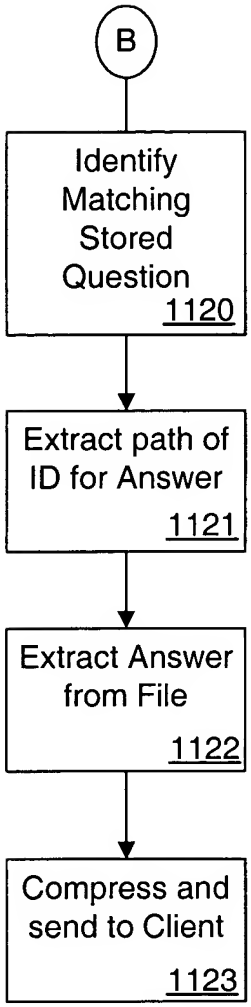

B
Identify Matching Stored Question
1120
Extract path of ID for Answer
1121
Extract Answer from File
1122
Compress and send to Client
1123

Fig. 12

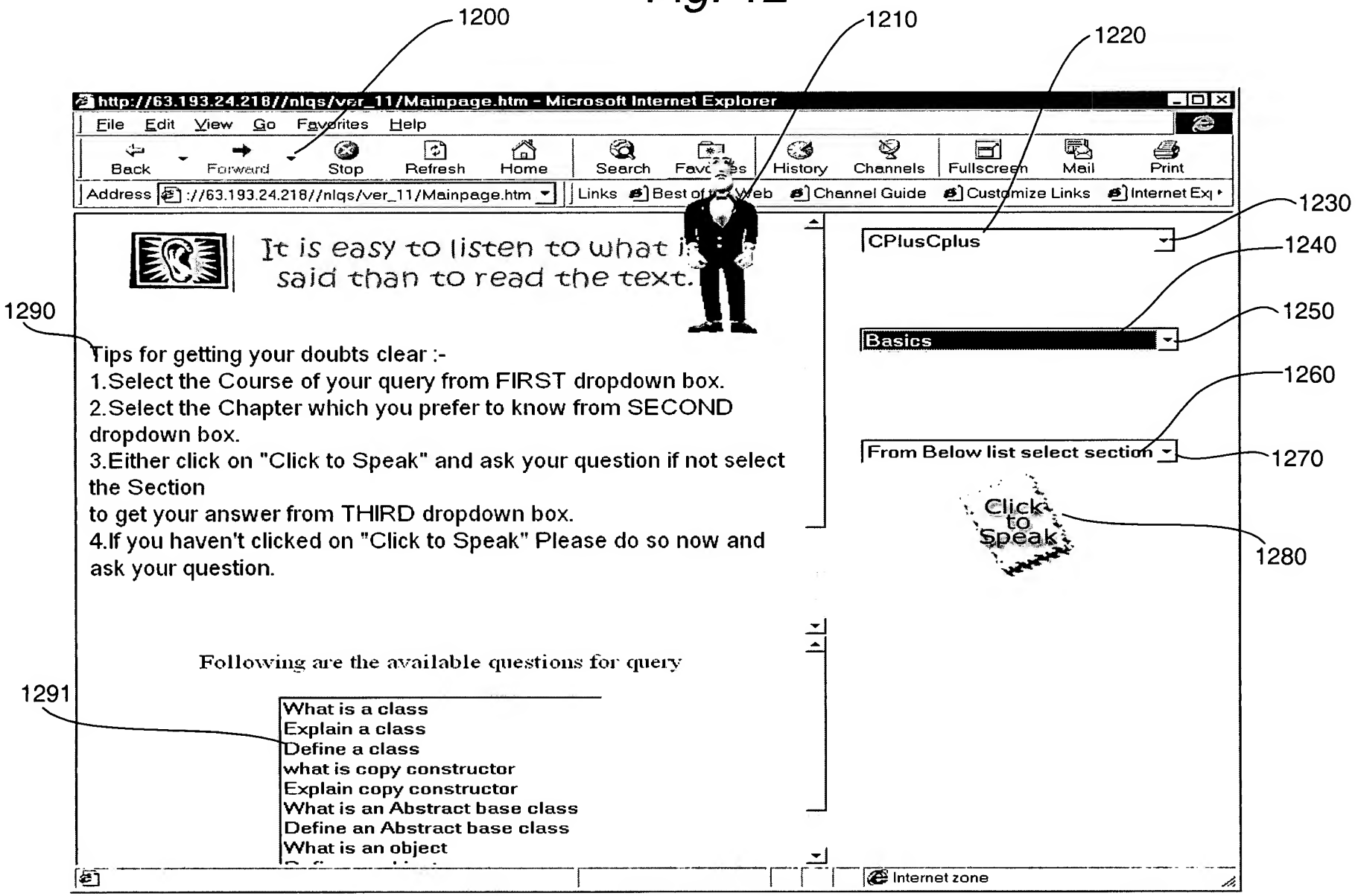

1200
1210
1220
1230
1240
1250
1260
1270
1280
1290
1291
http://63.193.24.218//nlqs/ver_11/Mainpage.htm - Microsoft Internet Explorer
File Edit View Go Favorites Help
Back Forward Stop Refresh Home Search History Channels Fullscreen Mail Print
Address ://63.193.24.218//nlqs/ver_11/Mainpage.htm
Links Best of the Web Channel Guide Customize Links Internet Ex
It is easy to listen to what is said than to read the text.
CPlusCplus
Basics
From Below list select section
Click to Speak
Tips for getting your doubts clear :-
1.Select the Course of your query from FIRST dropdown box.
2.Select the Chapter which you prefer to know from SECOND dropdown box.
3.Either click on "Click to Speak" and ask your question if not select the Section
to get your answer from THIRD dropdown box.
4.If you haven't clicked on "Click to Speak" Please do so now and ask your question.
Following are the available questions for query
What is a class
Explain a class
Define a class
what is copy constructor
Explain copy constructor
What is an Abstract base class
Define an Abstract base class
What is an object
Internet zone

Fig. 13

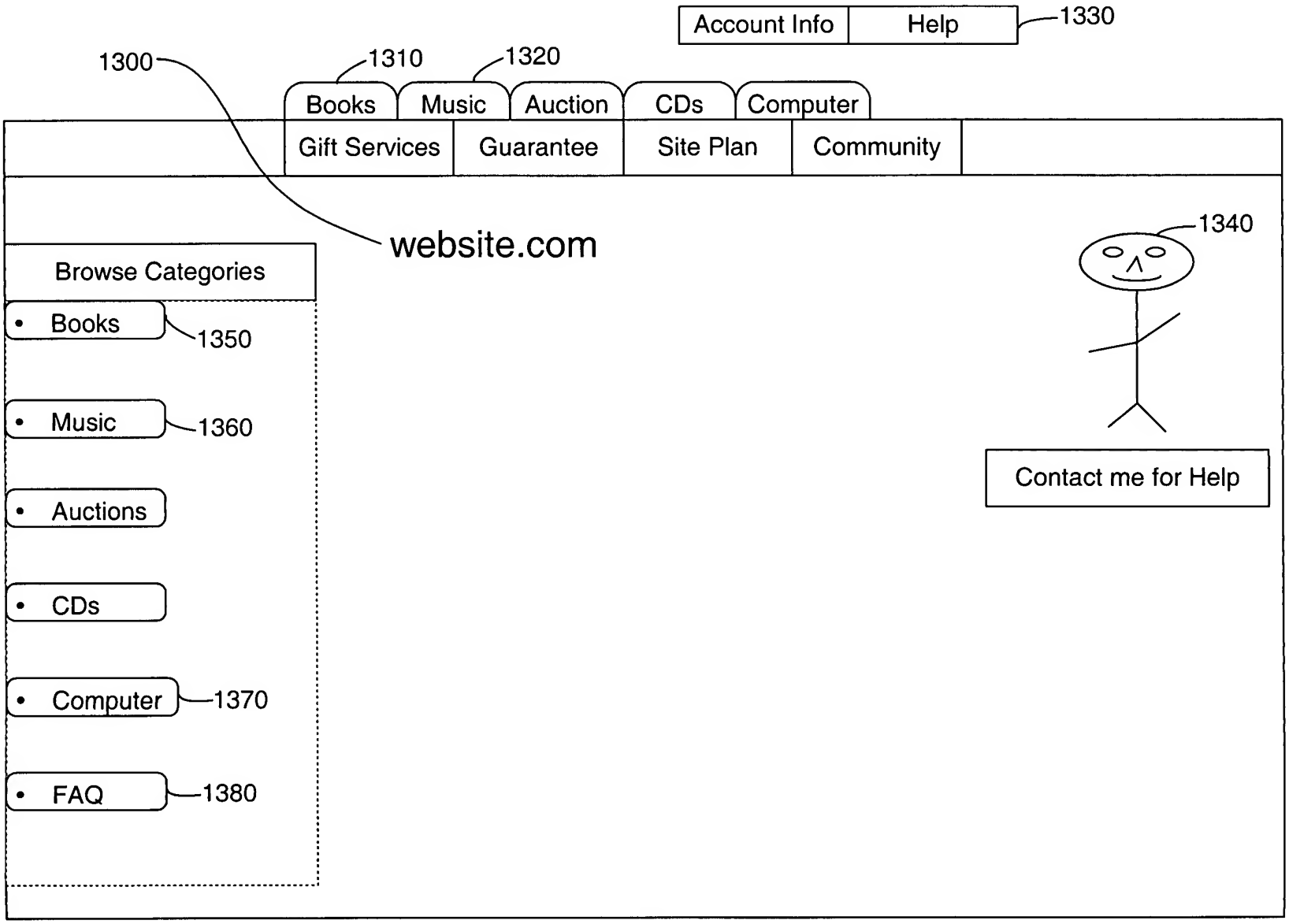

Account Info
Help
1330
1300
1310
1320
Books
Music
Auction
CDs
Computer
Gift Services
Guarantee
Site Plan
Community
website.com
1340
Browse Categories
Books
1350
Music
1360
Auctions
CDs
Computer
1370
FAQ
1380
Contact me for Help

Fig. 14

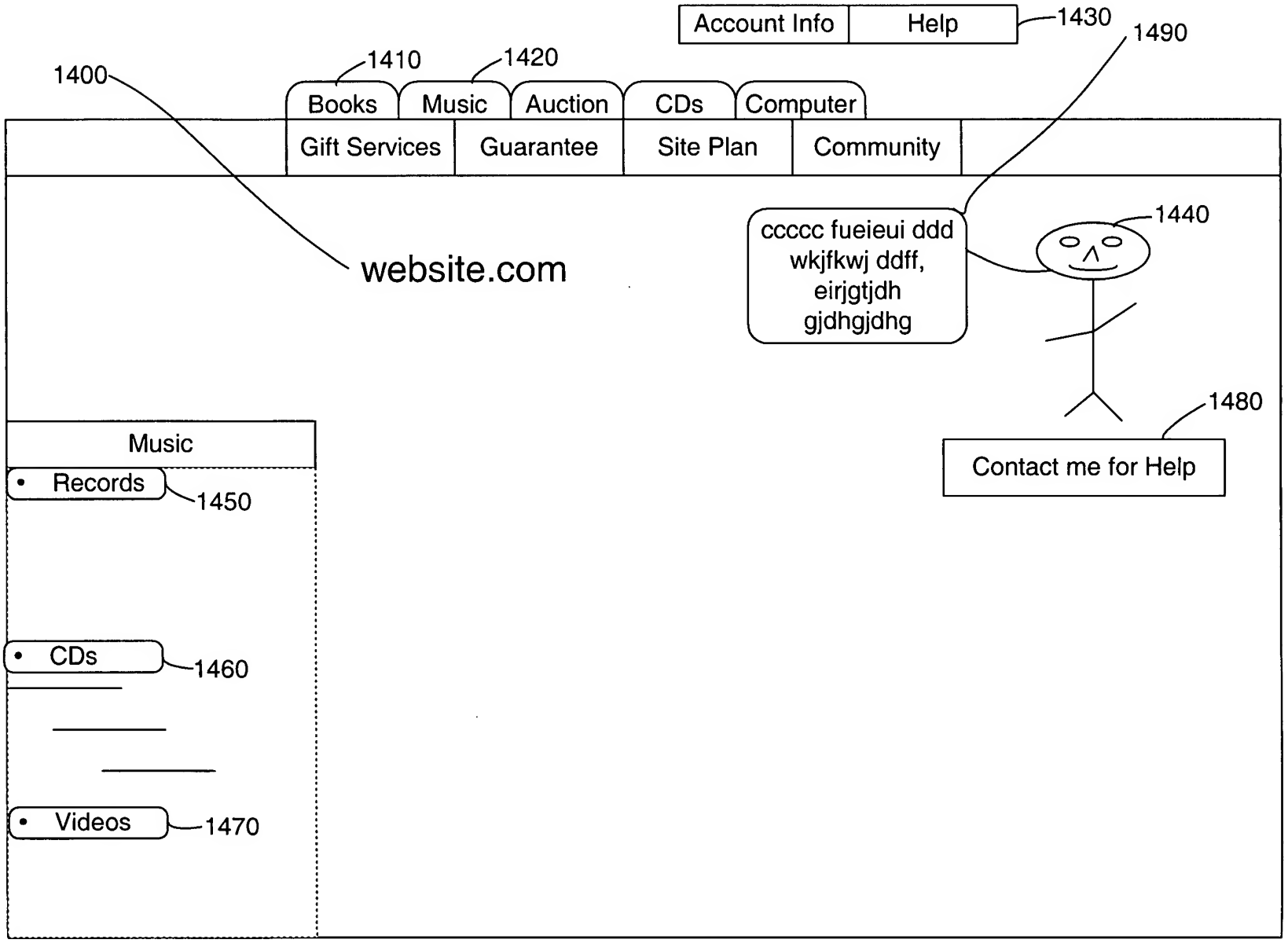

Account Info
Help
1430
1490
1400
1410
1420
Books
Music
Auction
CDs
Computer
Gift Services
Guarantee
Site Plan
Community
website.com
ccccc fueieui ddd
wkjfkwj ddff,
eirjgtjdh
gjdhgjdhg
1440
1480
Contact me for Help
Music
• Records
1450
• CDs
1460
• Videos
1470

Fig. 15

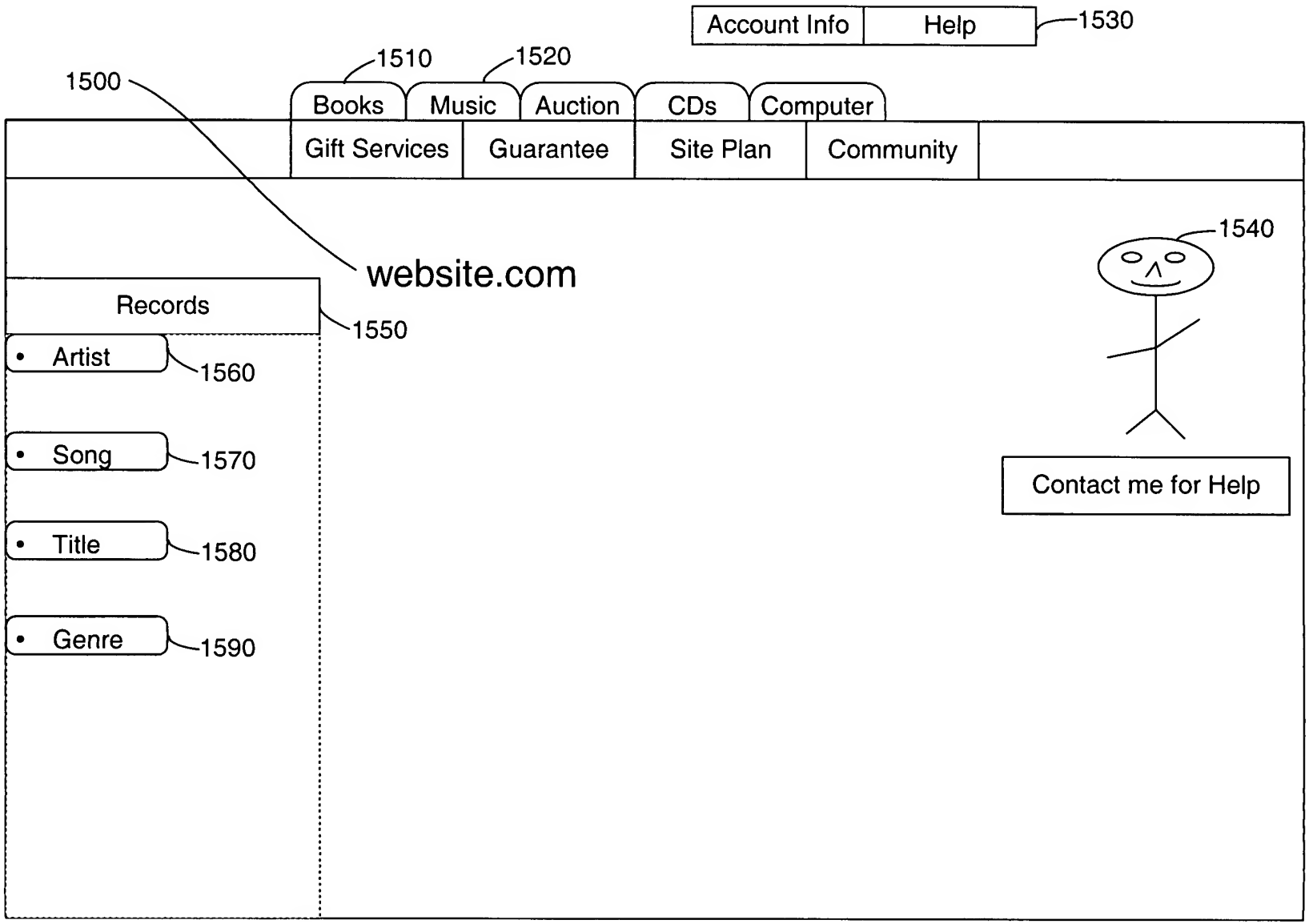

Account Info
Help
1530
1510
1520
1500
Books
Music
Auction
CDs
Computer
Gift Services
Guarantee
Site Plan
Community
website.com
1540
Records
1550
Artist
1560
Song
1570
Title
1580
Genre
1590
Contact me for Help

Fig. 16

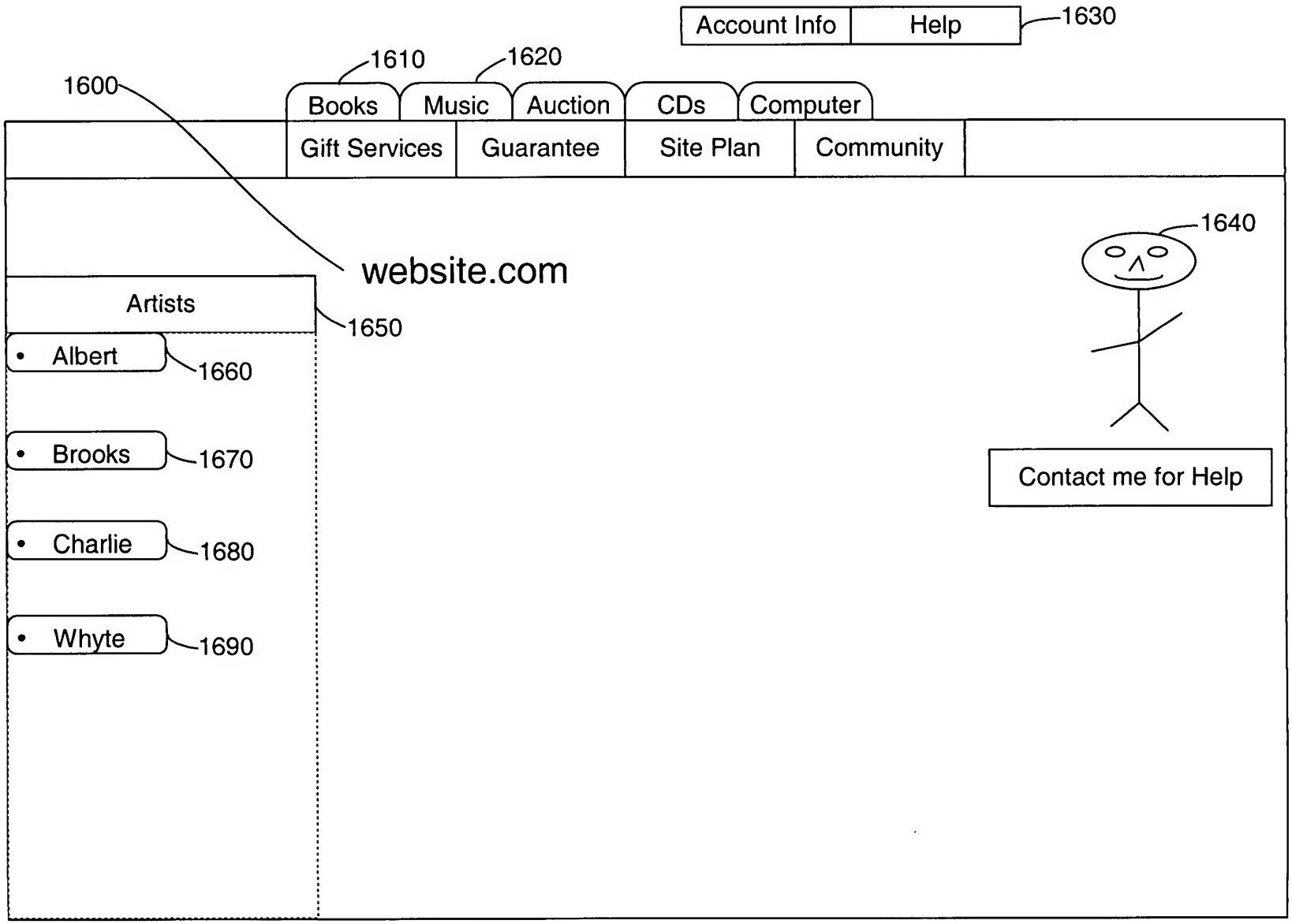

Account Info
Help
1630
1610
1620
1600
Books
Music
Auction
CDs
Computer
Gift Services
Guarantee
Site Plan
Community
website.com
1640
Artists
1650
• Albert
1660
• Brooks
1670
• Charlie
1680
• Whyte
1690
Contact me for Help

Fig. 17

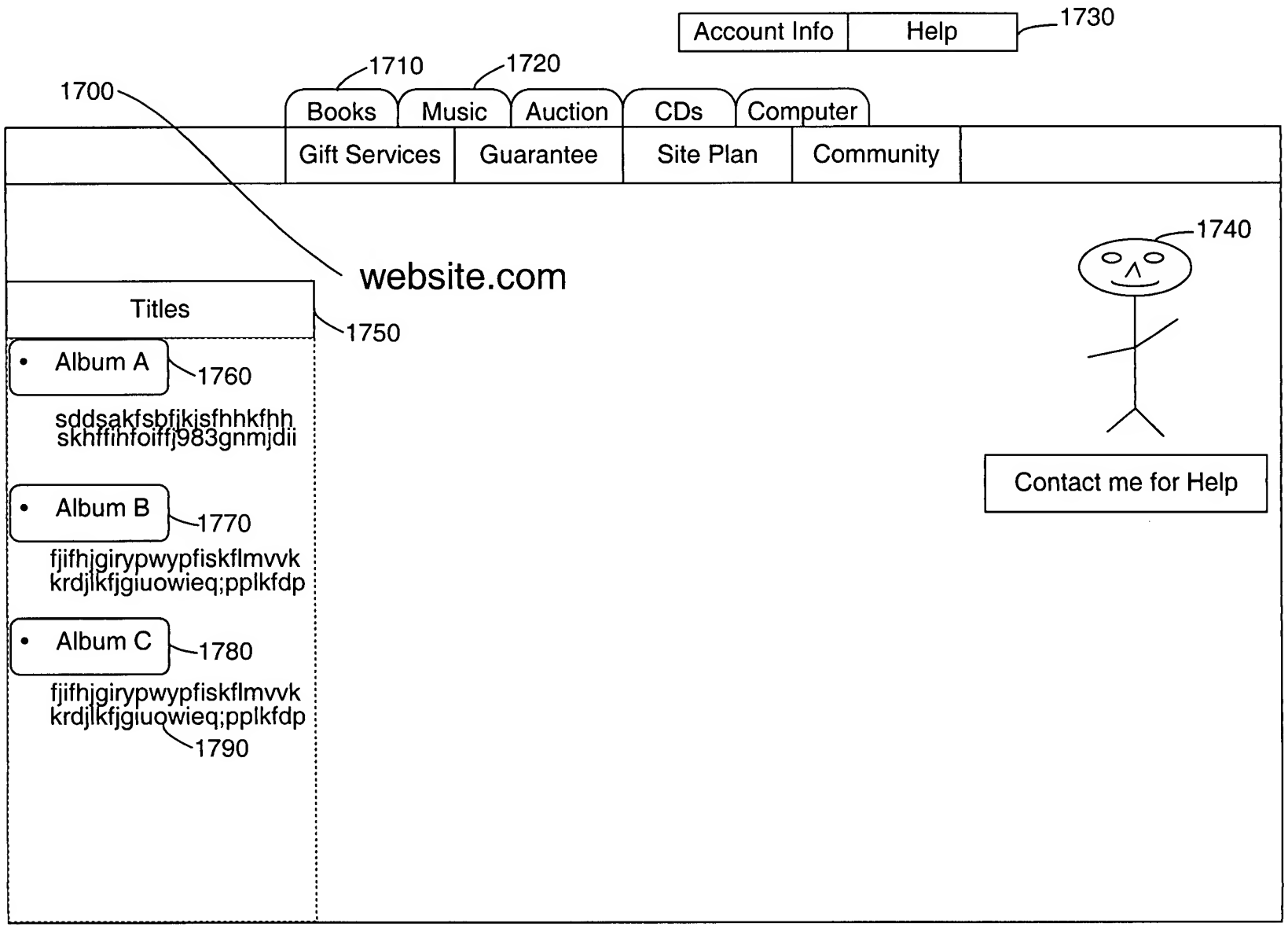

Account Info
Help
1730
1710
1720
1700
Books
Music
Auction
CDs
Computer
Gift Services
Guarantee
Site Plan
Community
website.com
1740
Titles
1750
• Album A
1760
sddsakfsbfjkjsfhhkfhh
skhffihfoiffj983gnmjdii
• Album B
1770
fjifhjgirypwypfiskflmvvk
krdjlkfjgiuowieq;pplkfdp
• Album C
1780
fjifhjgirypwypfiskflmvvk
krdjlkfjgiuowieq;pplkfdp
1790
Contact me for Help

Fig. 18A

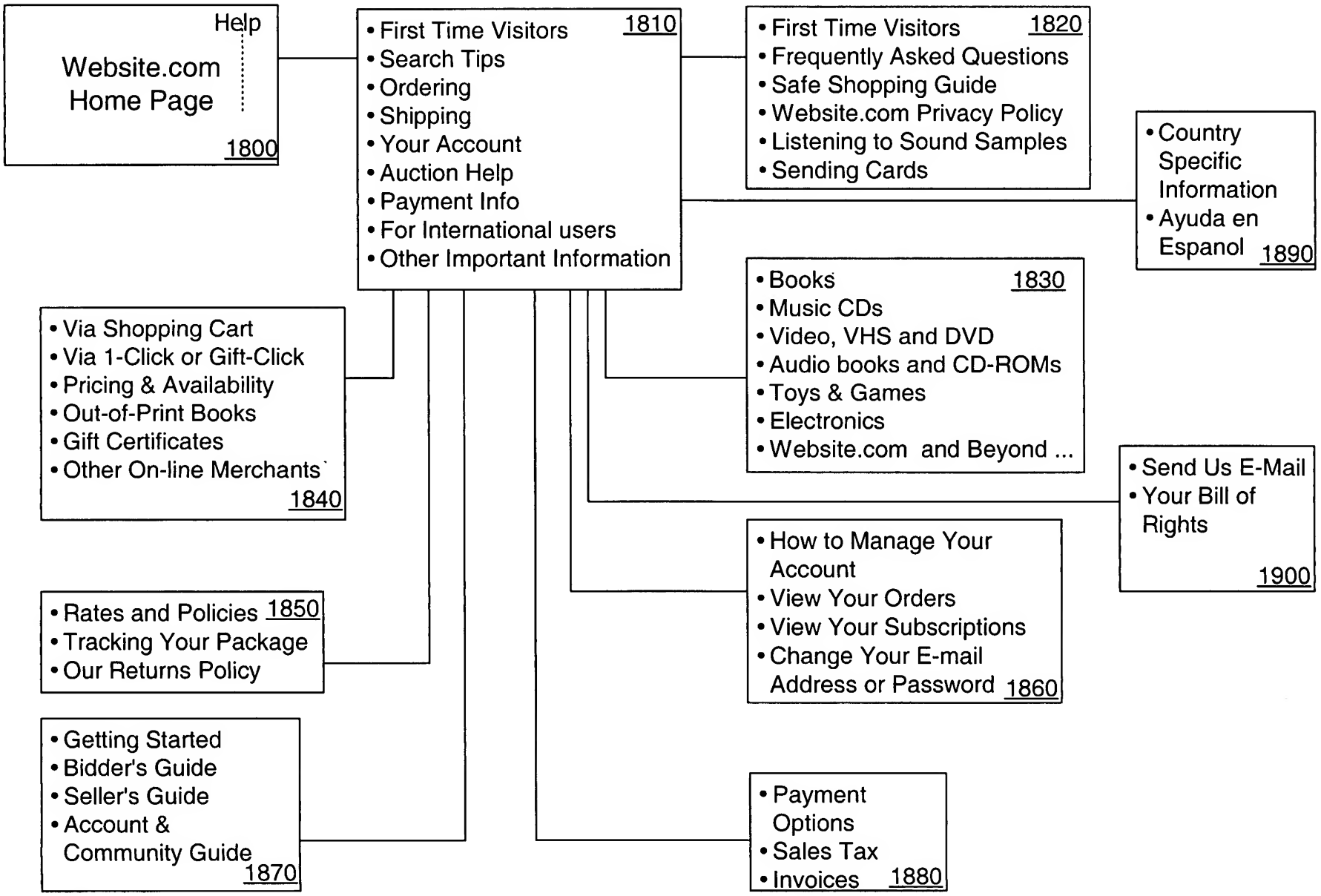

Help
Website.com Home Page
1800
• First Time Visitors
• Search Tips
• Ordering
• Shipping
• Your Account
• Auction Help
• Payment Info
• For International users
• Other Important Information
1810
• First Time Visitors
• Frequently Asked Questions
• Safe Shopping Guide
• Website.com Privacy Policy
• Listening to Sound Samples
• Sending Cards
1820
• Country Specific Information
• Ayuda en Espanol
1890
• Via Shopping Cart
• Via 1-Click or Gift-Click
• Pricing & Availability
• Out-of-Print Books
• Gift Certificates
• Other On-line Merchants
1840
• Books
• Music CDs
• Video, VHS and DVD
• Audio books and CD-ROMs
• Toys & Games
• Electronics
• Website.com and Beyond ...
1830
• Send Us E-Mail
• Your Bill of Rights
1900
• How to Manage Your Account
• View Your Orders
• View Your Subscriptions
• Change Your E-mail Address or Password
1860
• Rates and Policies
• Tracking Your Package
• Our Returns Policy
1850
• Getting Started
• Bidder's Guide
• Seller's Guide
• Account & Community Guide
1870
• Payment Options
• Sales Tax
• Invoices
1880

Fig. 18B

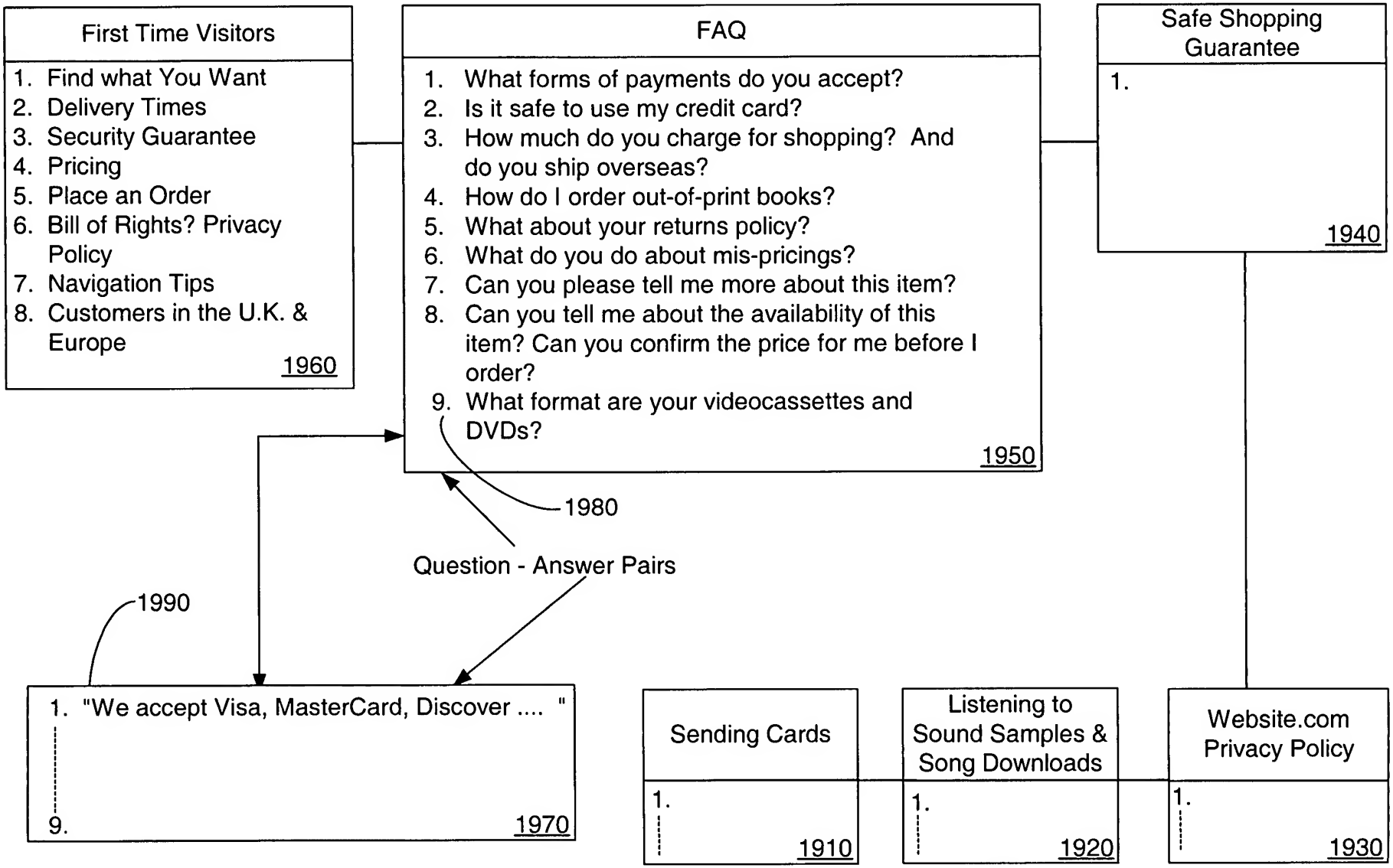

First Time Visitors
1. Find what You Want
2. Delivery Times
3. Security Guarantee
4. Pricing
5. Place an Order
6. Bill of Rights? Privacy Policy
7. Navigation Tips
8. Customers in the U.K. & Europe
1960
FAQ
1. What forms of payments do you accept?
2. Is it safe to use my credit card?
3. How much do you charge for shopping? And do you ship overseas?
4. How do I order out-of-print books?
5. What about your returns policy?
6. What do you do about mis-pricings?
7. Can you please tell me more about this item?
8. Can you tell me about the availability of this item? Can you confirm the price for me before I order?
9. What format are your videocassettes and DVDs?
1950
Safe Shopping Guarantee
1.
1940
1980
Question - Answer Pairs
1990
1. "We accept Visa, MasterCard, Discover .... "
9.
1970
Sending Cards
1.
1910
Listening to Sound Samples & Song Downloads
1.
1920
Website.com Privacy Policy
1.
1930

Fig. 19

Computing Semantic Distance
between User Query and Stored Qu estion

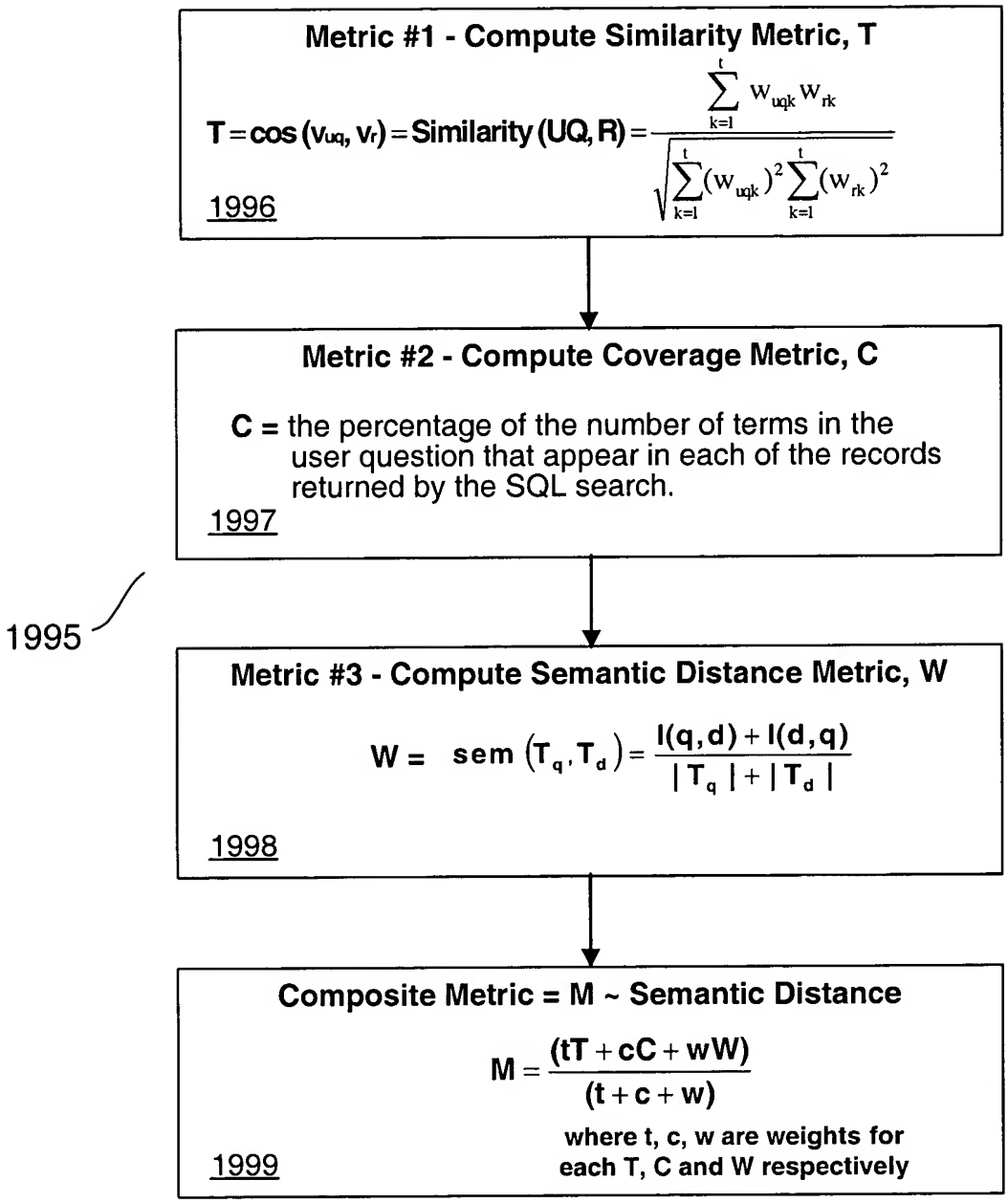


Fig. 20

Populating the Speech Lattice with Semantically Variant Questions

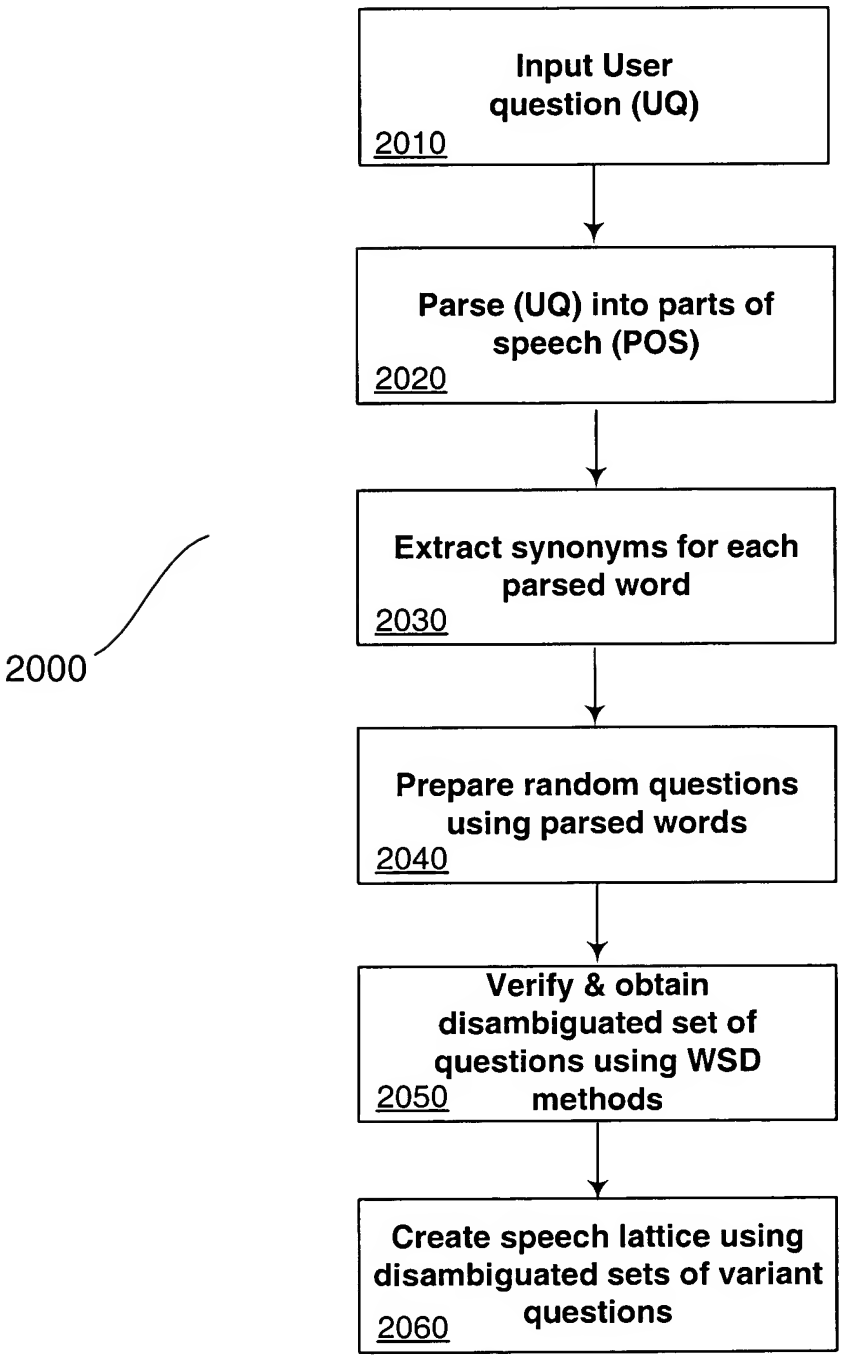


Fig. 21

Integrated NLQS Algorithm that combines WordNet-based Semantic- and Statistics-based Processing

2100

Integrated NLE Algorithm: Statistics- and Semantic-based Natural Language Processing

1. Query the database using the **LIKE** predicate for the exact **UQ**. If there is a match, go to step 6
2. Decompose **UQ** into noun phrases, verbs and other parts of speech and store into array
3. Query the database using the **CONTAINS** predicate for **NPs** and **Nouns**
   a. If the result set is == 0 then use **FREETEXT**
   b. Else - If no return, go to WordNet semantic processing (no direct match)
      c. If the result set is == 1 then go to step 6
   d. Else if the result set is > 1 then go to step 4
4. Query the result set using the **CONTAINS** predicate for the next preferred part of speech - e.g. **Verbs**, then **Adjectives**, then **Adverbs**
   a. If the result set is == 0 then revert to the previous **PQ** list and go to step 5.
   b. If the result set is == 1 then go to step 6
   c. Else if the result set is > 1 then repeat 4 with the next part of speech e.g. adjective
5. Now decompose the remaining **PQs** using NLE parser into the various parts of speech. Then do comparisons of the **NPs**, **Verbs** between the **PQs** and the **UQ**. Select the **PQ** with the highest score. Go to step 6 with selected **PQ**
6. Return the answer corresponding to the selected question (**UQ** or **PQ**)
7. If more than 2 questions have the same rank, then go to WordNet semantic processing